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In Memoriam

In sincere sorrow and with profound appreciation of their splendid service to the Society of the Sigma Xi, the national officers announce to the membership at large the death in Washington, D. C., February 24, 1939, of Colonel Frank Van Vleck, one of the founders of the Society; and the death in North Amherst, Mass., April 18, 1939, of Charles S. Howe, President of the Society in 1915 and 1916.

NUTRITION AND HUMAN WELFARE*

L. A. MAYNARD

Laboratory of Animal Nutrition, Cornell University

Everyone is made nutrition conscious these days. The modern child learns that there are such things as vitamins before he knows his alphabet. "Eat-more" campaigns confront us on every hand. Certainly a mixture of everything we are told to eat daily for health would, at least, result in one grand stomach-ache.

Clearly, some of the discoveries in nutrition have been greatly over-exploited in sales programs and even in popular writing. The true significance of nutrition research must be judged by its contributions to the body of scientific knowledge, and, because it deals with life, by its contributions to human welfare. These contributions provide the basis for assessing its promise as a field of scientific endeavor for the future. Such are my viewpoints in this talk. It is my hope that their discussion may prove of some interest to a group representing diverse fields of research, because the recent discoveries have been due primarily to the combined efforts of workers in many fields of both the physical and biological sciences.

In many fields of practice the teachings and guidance of science are accepted as final because the knowledge came originally and entirely from scientific studies. In the matter of eating, however, ages and ages of experience preceded any scientific knowledge. The extensiveness of this experience has frequently prompted the opinion that though nutrition research might explain established practices, it could not be expected to improve them. Such a viewpoint has been proven absolutely wrong by the developments of the last thirty years, as the history of the dietary deficiency diseases well illustrates. Such diseases as scurvy and night blindness date far back into history. The records show that various peoples learned some dietary means of combatting them. But each remained a scourge until, through animal experimentation and chemical research, the specific physiological failure was ascertained, the dietary factor was identified and its distribution in foods worked out. Such exact information is never produced by the empirical observations of dietary experience.

A special reason why experience has proven a very inadequate guide in developing an optimum diet is the changing food supply. The situation has been intensified by modern industrial developments, involving manufacturing, preserving and other processes which have markedly altered the character of the basic foods. The milling of cereals which results in a more palatable and more digestible human food, but which removes the better proteins and most of the minerals and vitamins, is a well recognized example of this development. Until very recently, the constant trend has been to more refined and less complete foods. For example, the annual per capita consumption of sugar, solely an energy food, increased twelvefold in the United States during the 100 years prior to 1920. This resulted in the displacement of more complete foods accordingly.

* An address delivered before the Cornell Chapter of the Society of the Sigma Xi.

Experience in the course of these developments focussed attention on the importance of dietary factors previously unrecognized when more complete foods have been in use, but it proved helpless to provide any adequate means of correcting the troubles. The creation of acute situations showed the necessity for a scientific study of dietary needs, and thus stimulated the modern experiments which have produced results of much more importance than the correction of the obvious troubles.

It is recognized that, under many conditions, nutrition ills are intimately associated with a low economic level; but this is no argument against the usefulness of nutrition research. More money provides a solution of the problem of getting enough to eat, but it offers no assurance that the nutritional quality of the diet selected will be satisfactory. This has been proven again and again by dietary surveys. Controlled observations have also shown that an improved health and efficiency can be brought about in the low-income groups by a wiser expenditure of the limited food budget. Nutrition ills are not limited to the poor and ignorant. A report of a committee of the League of Nations, based on several years' study of the relation of diet to health states "Deficiencies of diet and diseases of nutritional origin can be observed, not only among urban populations, but also among dwellers in country districts, and not only in poor and primitive countries, but also in rich nations with old and highly developed civilizations."

The specific knowledge that the body requires many different nutrients is recent indeed. From the time of Hippocrates up to the opening of the last century, it was believed that the value of any and every food depended upon the presence of a single, universal nutrient substance which was taken up by the various organs and tissues as the food passed through the body. This idea was dispelled by chemical and biological studies, showing that food consisted of at least three principles: protein, carbohydrates and fat. Throughout the nineteenth century, nutrition studies dealt mostly with these nutrients and with certain mineral elements.

In 1816 Magendie had produced evidence that protein was an essential nutrient by showing that dogs would not live on diets of pure carbohydrates or fat. This was the forerunner of the purified-diet method which during the present century has been responsible for so much of the modern knowledge. For many years, attempts to employ the method in animal experiments using diets containing sources of all the nutrients then recognized as essential, always led to the discouraging result that as the sources were more carefully purified the less satisfactory became the performance of the animals. Repeated results of this nature gradually led to the conviction, toward the end of the nineteenth century, that there were dietary essentials as yet undiscovered. During the next decade the perfection of the purified-diet method in several laboratories ushered in the modern era of nutrition research, responsible for the discovery of the vitamins and many other essential nutrients.

A series of experiments begun at the University of Wisconsin in 1906 and carried out for several years illustrates particularly well the varied course by which the newer knowledge was finally won and the part played by experimental animals. Babcock, the chemist, had long been interested in the nutrition of dairy cattle. He wondered whether all rations which were similar in terms of the

nutrients then known to be essential were actually of equal nutritive value. He conceived the idea of trying out rations made up entirely from a single plant. This proposal seemed decidedly impractical to animal husbandmen who, in those days, thought more of their cows than of the possible value of such an experiment. Eventually Babcock was given the use of two cows, but, when one died after three months, the experiment was abandoned lest another valuable animal be lost also. Later his idea was carried out in an extensive experiment by his younger colleagues, Hart, Humphrey, McCollum and Steenbock. One group of calves was placed on a ration made entirely from the wheat plant, another on a similar ration from the oat plant, and another on a ration from the corn plant. These rations were made up to be alike as regard their contents of all the organic nutrients then known to be essential.

In the course of the experiment, striking differences developed between the group on the corn plant and the one on wheat. The corn-fed calves early showed more vigor. When the animals were bred each of the corn-fed group produced a normal calf which developed satisfactorily, while all of the calves from the wheat group were either dead at birth or died soon after. The later results continued to be strikingly in favor of the corn plant. Exhaustive chemical studies of the feeds and excreta of the cows, and of the tissues of the calves which died or were killed, failed to find any explanation of the results. It was concluded that the wheat plant contained something toxic or, perhaps, that it lacked something supplied by corn.

During these experiments McCollum became convinced that such a problem could be solved only by the purified-diet method, and he was thus led to undertake experiments with rats. As a result, in 1914 he was the first to announce the discovery of vitamin A and eight years later he discovered vitamin D. Thus two of the most important contributions to better human nutrition were made. Having available the new facts learned through small animal studies, the cow experiment was repeated and the true cause of the failure on the wheat ration found. Thus a cow experiment which ended unsatisfactorily led to rat experiments which resulted in discoveries of outstanding importance in human nutrition, and these discoveries in turn solved the puzzling results of the original cow experiment.

The story has been repeated many times in the development of the newer knowledge of nutrition. Pilot experiments with a variety of species have disclosed the basic facts which have laid the foundation for improving the health and efficiency of both man and his animals. During the past twenty-five years these studies have resulted in the discovery of at least ten different vitamins, in the addition of four mineral elements to the list of essential ones, in the recognition of the vital rôles of specific amino acids in protein nutrition and in other important contributions.

The most striking feature of this development is the fact that the discoveries have been made by men trained primarily in the basic physical and biological sciences. Particularly, the discoveries have required the knowledge and techniques of these sciences to assess fully their physiological significance, to isolate and identify the elusive substances concerned and thus to provide the essential basic information for dependable methods of correcting the diet.

Vitamin A was discovered as a substance essential for growth and for the prevention of an eye disease, xerophthalmia, which occurred in its absence. It became the task of the physiologist and pathologist to identify the basic changes responsible for these external symptoms of physiological failure. It was found that in the absence of the vitamin from the diet the epithelial tissues throughout the body did not develop normally, which in turn was responsible not only for the eye troubles, but other equally important though less obvious effects, such as an increase in respiratory, gastrointestinal and urinary troubles and a specific failure of reproduction. These physiological findings illustrate the fact that vitamins have many relations to health besides the prevention of obvious deficiency symptoms. Herein lies one of the most important contributions of nutritional physiology to human welfare.

An equally vital rôle has been played by the physical sciences. The term, vitamin, was coined as an expression of ignorance. It represented an organic dietary constituent of unknown nature required in addition to the previously recognized essential nutrients. By feeding experiments the indispensability of vitamins could be shown and their distribution in foods could be roughly worked out. But what were these vitamins anyway? New ones were proposed with bewildering rapidity. It was realized that the body of knowledge being built up was becoming increasingly unstable because of ignorance of the nature of the substances being called vitamins. The situation was rapidly becoming chaotic until the organic chemist came to the rescue. The isolation, synthesis and establishment of the structure of vitamins represents a brilliant service to the field of nutrition, a fascinating story that cannot be detailed here. The contributions have come from many different laboratories representing a variety of scientific interests. Witness, for example, the isolation and synthesis of vitamin B in the Bell Telephone Laboratories.

To date the chemical nature of at least seven of the vitamins seems to be definitely established and marked progress has been made on others. The mystery surrounding them when discovered has been removed. The term, vitamins, becomes of only historic significance for those that can be called by a chemical name. They take their place as essential nutrients along with the amino acids, mineral elements and other known chemical substances which the body cannot synthesize from other food constituents. The isolation of the vitamins has enabled the nutritionist to work with the pure compounds instead of concentrates containing much larger amounts of many other substances. Experiments have become much more precise thereby, leading to the accumulation of more specific and reliable data than previously obtainable.

Along with the establishment of the chemical nature of the vitamins, chemical and physical methods for their quantitative determination have also been developed which are displacing the much more time-consuming and expensive procedures of biological assay. This is greatly accelerating the accumulation of knowledge as to the distribution of the vitamins in foods, and of their stability to the conditions to which foods are subjected in processing, storage, cooking and the like.

An important by-product of recent nutrition research has been the discovery and elimination from the diet of certain substances, present in natural or manu-

factured foods in amounts which were proving cumulatively harmful. The fluorine story is a case in point. This element appears to be a normal constituent of the bones and teeth. Back in 1925 it was shown that adding fluorine to the diet of a rat resulted in some peculiar teeth abnormalities and a chalky structure. This observation created no interest at the time, but it contributed to the important discovery six years later that an excessive fluorine intake was responsible for a defect of human teeth called "mottled enamel." The teeth are covered by chalky white patches, are structurally weak and more susceptible to decay. The trouble has long been known in various areas throughout the world. Its very common occurrence in Arizona and nearby areas resulted in systematic studies which revealed that the trouble was due to the unusually high content of fluorine in the water in the area. It was found that mottled enamel developed in children who regularly drank water containing as little as 1 p.p.m. Surveys showed the trouble to be much more widespread throughout the United States than previously reported. Injuries were found in farm animals as well.

It became apparent that the matter of water supply was not the only problem involved. The question was raised as to the influence of continued fertilization with rock phosphate products, known to contain 3-4 percent of the element, on the fluorine content of food crops or of the drainage water and thus of the water supply. Did the phosphoric acid made from rock and used in the preparation of certain human and animal foods provide a significant source in the diet? This was found to be the case for phosphate baking powders, and for certain phosphates used in proprietary infant foods and in animal feeds. Under the stimulus of the Food and Drug Administration these hazards are being removed. Phosphoric acid manufacturers have found a way to remove practically all of the fluorine from their product. Progress is being made in water treatment. The developments which were bound to make mottled enamel an increasingly serious problem are now under control and specific knowledge is available for the elimination of this important cause of defective teeth.

No discussion of the relation of nutrition to human welfare should omit the discoveries regarding pellagra which have been made within the past year. This disease is characterized by lesions of the digestive tract and the skin and by nervous symptoms. It has long been a scourge in certain areas of the world. In this country 170,000 cases were recorded in 1917, principally in the southern states. A dietary cause was early suspected and after 1920 evidence accumulated rapidly that the disease was due to a specific deficiency. Encouraging results were obtained by dietary changes but several thousand deaths annually continued to occur, for the knowledge was not sufficiently specific. The elusive factor concerned remained a mystery. Experiments were centered on a similar disease in dogs called "black tongue," and extracts of liver and other foods were found to correct the trouble.

Less than nine months ago, following the isolation of nicotinic acid amide from liver extract, the cure of black tongue by the crystalline acid was announced. Within the past six months the cure of human pellagra by the use of nicotinic acid has been reported by five groups of investigators and no cases of failure have been recorded. The response is dramatic indeed, for an intake of half

a gram of the acid causes a healing of the mucous membrane lesions in forty-eight hours. Clearly the findings are too recent and too fragmentary to dare hope that the long baffling problem has been completely solved, but the initial results are remarkable indeed. Nicotinic acid has remained a compound of no particular interest or importance since its discovery seventy years ago. It now becomes of vital nutritional significance.

I have given various examples of how the new discoveries are contributing to human welfare. The accomplishments to date unmistakably suggest that the nutrition field will continue to provide unusual opportunities for contributions by men who are thoroughly trained in the basic physical and biological sciences. They also give us a vision of the broader objectives that should be held in mind. Again quoting from the League of Nations Report: "Nutritional research will exercise a greater influence in preventive medicine by increasing the vitality of the human species than by preventing the frank 'deficiency diseases.' The health of the individual, in the majority of cases, is destroyed not so often by severe attacks of illness (which are more in the nature of accidents) as by the gradual action of persistent but unrecognized causes of which one of the most important is a badly composed dietary." The future accomplishments should be measured in terms of their contributions to the health and productivity of the life span as a whole, in all that is here implied. This is a broad objective indeed which has received far too little attention in the past.

The vast majority of experiments upon which our current nutrition practices are based have dealt with the young and growing organism. Most commonly, a maximum rate of increase in weight and size and the absence of gross symptoms of deficiency have been the criteria of successful performance. Certainly these are very inadequate measures of the optimum, coordinated development of the diverse organs and tissues which comprise the animal body. Growth should be looked upon primarily as preparation for life—as the development of an adult body which has the capacity for a healthy, productive life and in which the infirmities and degenerative diseases of old age are postponed as long as possible. These qualities are not guaranteed by a rapid rate of growth or by the attainment of a maximum weight or size.

Studies in our laboratory with rats have shown that the senile changes of old age can be postponed and the length of life markedly extended, by slowing down the rate of growth in weight and size through calorie restriction in a diet otherwise adequate in all known essentials. These results justify no conclusion that the retardation of growth is desirable in practice. Certainly they have no immediate application to man. Their present significance lies in the basic facts established. They have demonstrated that the life span is far from being the fixed unit previously believed, that it can be markedly extended by dietary means. They have shown that the capacity to grow can be exercised far beyond what has been considered the normal growth period. A mass of data has been accumulated relative to the onset of degenerative changes which mark the end of productive life and the development of senility. A new and effective technique is afforded for studying the aging process.

The experiment has raised important questions as to the relation of growth to productive life and longevity. It emphasizes our ignorance of many of the

factors involved in optimum growth. It is possible that in stressing increase in weight and size we have neglected factors vital to the complete development upon which later production and longevity depend. The enhanced growth in weight and size which has resulted from large intakes of recently discovered dietary essentials may be accentuating the limiting effect of as yet unidentified factors required for complete development and continued function. There may well be no conflict between rapid growth and length of productive life, provided the growth obtained is complete and correlated in all its aspects. The physiology of growth must be much better understood before a diet optimum for its support can be formulated. Here lies a wealth of problems for the chemist, physicist and biologist.

I have mentioned that our current dietary recommendations and practices are based for the most part on experiments carried out during the growth period only. In the absence of other evidence it has been rather generally assumed that the facts found in growth experiments can serve as a guide for optimum nutrition throughout life. But the influence of the diet after middle life must be considered in terms of the changing physiology involved. Cowdry in his book "Arteriosclerosis" has pointed out that during the ascending period of life the formation of functionally efficient protoplasm predominates, whereas the period of decline is characterized by increasing disintegration of active tissues, by the accumulation of unremoved waste products and by the formation of pathological deposits. The large rôle which nutrition plays in the ascending period has been extensively studied. Clearly it must have a rôle also in connection with the senile changes of old age, but this period of the life span has been almost totally neglected. In view of the changing physiology it is clearly unsafe to assume that the diet which is optimum for the growth period is suitable throughout adult life also. The aging period deserves independent study.

A single example will serve to illustrate the point. A child falls down a dozen times a day with no ill effects; an old man falls and he breaks his hip. It refuses to heal. What structural changes in the bones are involved? In the growing period the strength and density of the bones can be markedly influenced by dietary relations, notably by calcium, phosphorus and vitamin D. But these nutrients do not suffice to prevent the development of brittleness after middle life, despite the fact that an active metabolism continues in the bone. What are the physical and chemical changes which are correlated with brittleness? Can they be retarded by any dietary factors? One must approach this problem from the viewpoint that the metabolism which occurs in aging may be different in various respects from that taking place during growth and that the same may well be true for the dietary relations concerned.

Clearly the program here outlined for studying the rôle of nutrition in productive life is far more than a nutrition project alone. In addition to any nutritional relations discovered, the new facts gained with regard to the chemistry, physics and physiology of body processes will contribute to the science of life itself and, thus, to all fields of biology; for living systems are based on chemical and physical organizations.

(Please turn to page 102)

DRUG ADDICTION PROBLEMS*

M. H. SEEVERS

To the layman lacking first-hand experience with addiction, the term "drug addict" may conjure a mental image of a sallow-skinned, hollow-eyed Oriental, who in his utter depravity is clutching with bony, long-nailed fingers at the throat of a young girl or suckling babe. Such a picture of addiction is commonly portrayed in the Sunday supplements or in the literature of the professional reformers.

A characterization such as this, although it may have its physical counterpart in actual life, does not portray the true condition of the average addict; neither does this type of sensationalism contribute to an appreciation of the problems of drug addiction by the laity. Such a caricature of the addict is too unreal and so difficult to harmonize with everyday experience, that the intelligent individual is prone to scoff, shrug his shoulders, and refuse to be impressed with the fact that an addiction problem actually exists "West of Suez."

Before turning to a discussion of the individual addict, and his problems, let us examine the facts which are at hand, to ascertain whether an addiction problem of any proportion actually does exist in the United States. The figures and estimates which will be considered have been gathered by scientific representatives of the Bureau of Social Hygiene,¹ the U. S. Public Health Service, and other agencies of like caliber. These representatives, lacking the zeal of the professional reformer, probably have less of an incentive to distort the facts.

Let us consider, for the moment, only those facts pertaining to opium and its principal derivatives, morphine and heroin. With the possible exception of alcohol, addiction to these compounds is undoubtedly the most widespread.

In 1918, four years after the passage of the Harrison Narcotic Act (a congressional act regulating the manufacture, sale, and dispensation of narcotics), a Special Committee of Investigation, appointed by the Secretary of the Treasury, sent a questionnaire to all physicians licensed under the Act, requesting a report on the number of addicts in their immediate care. Thirty percent of these physicians reported, stating that they had under their personal care a total of 70,000 addicts to opium and its derivatives. If we assume the same incidence to obtain for the 70 percent of the physicians who did not report, we would arrive at a total estimate of approximately one-quarter of a million addicts under the care of physicians, or about 1 in every 400 of the population; but this figure probably does not represent the total number of addicts in this country. It is a well-recognized fact that a large number of addicts, probably a majority of the total, particularly those who obtain their drug through illicit channels, never come under a physician's care.

In 1928 a comprehensive survey of the problem was made by the Committee on Drug Addictions of the Bureau of Social Hygiene. After reviewing the known facts, including those just reported, other statistical information

* An address presented in substance before the Wisconsin Chapter of the Society of the Sigma Xi.

obtained largely from police records relative to the incidence of addiction in large centers of population, and many others, they came to the conclusion that it was not improbable that nearly 1,000,000 individuals were addicted to narcotics in the United States. This astounding total would represent nearly 1 percent of the population.

Suppose we are inclined to doubt these statistics. Even the most conservative estimates place the total number of addicts in excess of 100,000—one in every thousand of the population. Irrespective of which estimate we accept, it must be generally agreed that such a condition constitutes a social and medical problem of major significance, even for the United States.

Let us examine very briefly certain international aspects of the problem. If the economists are correct in asserting a definite relationship between supply and demand, then it should be possible to draw certain inferences regarding the extent of addiction throughout the world by examining the figures for the total world production of opium in relation to the estimated needs of the world for medical and scientific purposes.

Such an analysis has been made by the Health Committee of the League of Nations, the Opium Advisory Committee, a mixed subcommittee representing both of these, and the Commission of Experts of the Second Geneva Conference. There emerged from the discussion of these groups the following figures, which may be accepted as representing generously the amount of raw opium and crude cocaine needed *per capita per annum* for the uses by that population of the world within reach of medical service. Their estimate, at 450 milligrams *per capita per annum*, totals about 340 tons of crude opium (eleven carloads). If we are exceedingly liberal, and allow the same quantity for every man, woman, and child in the world, this figure becomes about 850 tons of crude opium.

"Nobody really knows how much raw opium—still less how much coca-leaf—is produced in the world. But the various kinds of estimates, produced by those with motives whether to exaggerate or to minimize the production, and by those whose aim is only to know the truth, come out at last to a probable total world production . . . of about 8,600 tons¹² (or 240 carloads).

This would represent 70 grains (one-seventh of an ounce) or about 70 average therapeutic doses for every living person on earth.

It is significant that this estimated total is "*more than ten times what we have seen to be the outside possible legitimate needs of the world.*"¹²

Unquestionably, this excess finds its way into the hands of users through other than legitimate channels.

Thus far we have considered only opium. Addiction to cocaine, although probably less widespread, is no less significant. Using similar methods of calculation as those already described, estimates based upon a *per capita per annum* need of 7 milligrams, bring the world total to 14 tons. Figures presented for the total production of cocaine are exceedingly unreliable and difficult to obtain. Let me call your attention, however, to a quotation from the *Spot Goods Reporter*, published in Yokohama, Japan, on October 2, 1920. The purpose of this circular is to bring together, "confidentially and with the strictest discretion," buyers and sellers of any kind of merchandise.

"No. 810, Code-word MAHTO—COCAINE, crystal. Can supply any amount up to 1,000 tons. In 25 oz. tins. BOEHRINGER'S brand. Y21 per ounce, duty paid, spot Tokio."

According to J. P. Gavit,² who stands as authority for the above quotation, "up to 1,000 tons," in the trade parlance of the Far East means "quantity unlimited; go as far as you like." Two conclusions are obvious: either the market is glutted with this drug or the demand far exceeds any legitimate need.

Of alcohol, little need be said. Repetition probably only tends to minimize the problem in the public mind. The use of the hemp plant, Cannabis (marihuana, hashish), is on the increase, as judged by the attitude of governmental agencies when handling those convicted of the possession or dispensation of this compound. This reaction may come from the recognition that widespread addiction to this substance among adults would be a serious indictment of the mental caliber of the constituency of this or any other country. Its effects are so bizarre as to appeal primarily to the individual who has never known anything but an abnormal psychic state but hopes to modify it, for the better, in the fumes of this compound.

Suppose we assume, then, at least for purposes of discussion, that an addiction problem exists not only in China, and India, and South America, but also in the United States.

What is drug addiction? Why is it a medical and social problem? How does it differ from habituation to tobacco, coffee, tea, etc.?

Before proceeding further, it might be well to consider a definition of addiction. It is not an easy condition to define, even in medical terms. It is often used as a synonym for habituation. In spite of this erroneous usage, a clear-cut differentiation should be made between addiction and habituation. In light of the following definitions, every addict is also an habitué, but the habitual use of drugs does not always imply addiction.

Definitions have been given as follows:³

"Addiction is a condition developed through the effects of repeated actions of a drug such that its use becomes necessary and cessation of its action causes mental or physical disturbances." These disturbances are termed *abstinence symptoms or signs* and are "definite and more or less characteristic symptoms occurring in addicts on sudden withdrawal of their drug."

"Habituation is a condition in which the habitué desires a drug but suffers no ill effects on its discontinuance."

Addiction, in most instances, implies a *physical* as well as *psychic* dependence upon the agent which is responsible for the altered physiologic state. The continued presence of the drug in the body is the *sine qua non* of a fairly normal mental and physical activity. On the other hand, the individual habituated to the repeated use of a non-addicting drug notices its absence, may yearn for it, may even be psychically disturbed because of the deviation from his usual routine. There are, however, as far as we are aware, no reports of death resulting from sudden deprivation of the habitual cup of coffee or the after-

dinner cigar, such as may occur if the addict is deprived of his usual quota of morphine or the chronic alcoholic his daily quart of whisky.

It is safe to say that an individual may become *habituated* to the use of any drug. Whether addiction is the sequel to this habituation depends upon the character of the drug chosen by the habitu  , and in large measure, upon his previous psychic state. One school of psychiatry holds that the presence of addiction is, *ipso facto*, proof of a prior state of psychoneurosis.

Is it possible to use the reaction of the individual to society as a means of differentiating addiction and habituation? Drugs of habituation usually harm only the user and do not, as a rule, affect his fundamental reactions as a social being, except possibly in a financial way; on the other hand, the change in personality of the addict, resulting from the direct action of the drug (cocaine) and/or from its absence (opiates), is responsible for the urge to commit antisocial acts.

At this juncture it might be well, for the sake of clarity, to differentiate a type of acute poisoning with those drugs which cannot be logically classified as either habituation or addiction. It certainly would be incorrect to refer to the novice to alcohol, indicted for manslaughter as a drunken driver, either as an habitu   or as an addict.

The principal drugs of addiction are: opium and its derivatives, morphine and heroin; alcohol; cannabis, and cocaine. To this group may be added the barbiturates, paraldehyde, chloral, and other depressants, all of which in large dosage over a long time period may, in some individuals, produce addiction.

These drugs of addiction may be separated into two rough groups—those which produce, primarily, a depression of the nervous system, and those which are stimulant or excitatory. It must be pointed out that this is a pharmacological classification based upon predominant action upon the central nervous system as a whole and is, in some respects, arbitrary. All of these compounds with the exception of cocaine may be considered as depressants of the nervous system, although they are often used to obtain a subjective reaction of a stimulant character. You may question immediately the validity of classifying alcohol, for example, as a depressant since its early subjective and objective manifestations are commonly those of stimulation. According to present interpretation, however, the apparent stimulation is a phenomenon of release from cerebral inhibition rather than a true cellular stimulation. As such, it is only a transient episode in the total action of the drug, since it is followed by the manifest signs of depression. It may well be that the motor stimulation from cannabis or the "psychic stimulation" from the opiates is of a similar nature. Cocaine, on the other hand, produces a definite and true stimulation of the motor, and probably of the sensory, areas of the cerebral cortex.

The principal drugs of habituation are nicotine (tobacco) and caffeine (coffee, tea, Coca-Cola, etc.). To this group may be added an almost unlimited number of compounds or mixtures, many of them proprietary remedies which are used repeatedly and habitually. Among the most common are the pain killers, aspirin, acetanilid, etc., and the sedatives, barbiturates (in small doses), bromides (Bromo-Seltzer), etc. There is little doubt but that excessive use of any of these substances may result in injury to the habitu  , but the injury is usually of a different nature from addiction.

It must be appreciated that any classification of compounds as here presented is in part arbitrary. Even the drugs of habituation in excessive dosage over a long time period may occasionally lead to addiction in the real meaning of the term. The best example of this is the group of barbiturates. Small doses may be administered for years without leading to addiction but large quantities produce definite lesions of the brain and abstinence symptoms appear upon withdrawal of the drug. Probably not a single one of these drugs is entirely innocent. Consider, for instance, such an apparently simple substance as coffee with its alkaloid, caffeine. Few of us would like to admit that we are caffeine addicts; yet I will venture to say that there are many in this room, such as myself, who will develop a headache before noon if we are deprived of our habitual cup of breakfast coffee or its equivalent in caffeine from tea or Coca-Cola. Do we have, then, in caffeine a drug which possesses in a small measure the requisites of a drug of addiction? Do the blood vessels of the brain become dependent upon caffeine so that its presence is necessary to permit an adequate flow of blood to this organ? These are questions which I will not assay to answer. Certainly caffeine cannot be placed in the same category with cocaine, from a practical viewpoint.

The classification as briefly outlined serves a useful practical purpose. Those compounds listed as producing habituation are relatively unimportant in the present discussion, since in the vast majority of cases they do not result in addiction. Those drugs which are listed as depressants, with the exception of cannabis, are of value to the physician and addiction may follow their therapeutic use. Furthermore, if addiction has progressed to a serious state, a train of physical as well as psychic disturbances occur if the drug is withheld. The signs and symptoms of abstinence are definite and in many instances characteristic.

Addicts to cannabis and cocaine are of a different stripe. Addiction, in this case, is usually a manifestation of a psychopathic desire to escape from reality—a sequel to vicious associations—or the need for an inflation of the personality. The addict to these compounds can rarely attribute his state to errors in therapy. Peculiarly enough, no definite and characteristic physical signs or symptoms follow withdrawal from these compounds, as is the case with the opiates. The cocaine addict is subjectively depressed and desires the drug intensely; he may even commit murder to obtain it; yet the physical manifestations of withdrawal are not characteristic. The same may be said, in the main, of addiction to the resin of the hemp plant, Cannabis. These facts have led to the use of the term "psychic addiction"³ to differentiate the actions of these latter compounds from those of the depressant group. It should not be inferred from this usage that addiction to these compounds is any less severe or difficult to cure. The term "psychic addiction" is not an ideal one since the manifestations of abstinence from any of the drugs of addiction are partly psychic. It may be considered to indicate, first, an absence of characteristic physical signs of withdrawal and, second, a willful and probably, in part, a psychopathic desire for the drug, not necessarily to afford relief from the symptoms of abstinence, but for its capacity to change one abnormal psychic state to another which may be less unpleasant. Possibly a more descriptive, if not entirely correct, term would be "psychopathic habituation."

Broadly speaking, it might be said that the potential addict, if he so becomes by choice, probably selects his drug of addiction to suit his personality. A nervous, irritable, worried, or grief-stricken individual may find temporary solace in the apathetic and dreamy state produced by opium, morphine, heroin, or a barbiturate. Individuals of this type may be addicted for long periods (providing they have access to the drug) without becoming a social problem. If they are deprived of the drug they usually become a burden on society. From this class may come many petty criminals, thieves, shoplifters, etc. Occasionally, when in a suggestive state, these individuals may, at the instigation of another, commit crimes of passion. Usually, however, individual initiative is reduced to a minimum. There is no such entity as the "heroin" hero of the dime novel.

The phlegmatic, egocentric individual with a subjective awareness of inferiority may temporarily inflate his personality to become the "king of all he surveys" by the use of cocaine, hashish, or in many instances, alcohol. The inflation of personality produced by these drugs is responsible for the acts of aggression committed under their influence. Unrestrained crimes of passion are not uncommon. The potential bank robber finds in the white crystals of "snow" (cocaine) the temporary, but necessary, courage to complete his drama, even though murder becomes an essential to its success.

The foregoing statements are obviously generalities and it would be an error to leave the impression that all addicts are vicious or that they come from the lower strata of society. This would be far from the truth. The factors responsible for addiction are many: as examples may be cited, easy access to the drugs (physicians, nurses, dentists); injudicious use by physicians (therapists); vicious associates. It is a fact that the addict is usually a good missionary and that he attempts to convert to his particular "master" those with whom he is associated.

It is interesting to note that during addiction each drug induces fairly characteristic personality changes, or at least accentuates personality traits which are already present. This is not always apparent to the layman, but the psychiatrist can often diagnose the drug of addiction from the personality of the addict. A striking example, confirmatory of this statement, is to be found in De Quincey's "Confessions of an English Opium-Eater." These writings, while generally considered to be classic examples of composition, are not the usual peregrinations of an individual addicted solely to opium or its derivatives. To quote Terry and Pellens¹:

"The opium user, even of De Quincey's time, as far as we can determine from the literature, did not boast of his affliction and De Quincey's eulogy of the drug and his desire to appropriate to himself credit for an intimate knowledge of its alleged virtues, therefore, do not seem to be characteristic of the opium user. Probably no better example of this attitude of De Quincey, which may of course have been the all too common egotism of the artist, could be found than the following quotation from his Confessions:

"This is the true doctrine of the Church on the subject of opium: of which church I acknowledge myself to be the *only* member—the alpha and omega."

"May not this attitude be rather the psychologic picture of the alcoholic with his very common megalomania? In this connection, it should be remembered that the preparation used by De Quincey was laudanum which contained 45 percent of alcohol, so that at the time that he was taking a pint—8,000 drops—a day he was consuming the equivalent approximately of a pint of whiskey. In addition to this amount of alcohol, as his biographers show, he was a generous partaker of wines and cordials. It is, therefore, not astonishing that the evidence of alcoholism is at least as plain as that of chronic opium poisoning. His was really a case of mixed intoxication and he presented somewhat the picture of the more modern indulger who adds cocaine to his hypodermic of morphia or his sniff of heroin. The same characteristics are to be found in certain other writers and statesmen of genius all of whom used an alcoholic preparation of opium."

What are the changes produced in the individual by a drug of addiction? It will suffice here to describe in brief the general effects of morphine.

The period of initiation or euphoria has been aptly called the honeymoon of the morphinomaniac. Under the influence of the morphine, physical pains, if they exist, disappear or become abated, the organic functions become more active, and the mind lapses into a pleasant reverie; ideas form themselves without any effort and combine "to form ingenious conceptions, elaborate resolutions, vast projects which, alas, are never likely to last through the day," depressing thoughts disappear and life assumes a smiling aspect.

After a short period, many subjects, conscious of their danger, make efforts to escape from it. They diminish the doses, reduce the number of injections, etc. Some even completely discontinue the use of the drug permanently or temporarily.

As morphinism becomes established certain permanent changes of a psychic nature occur. These consist in a general weakening of psychic activity and are manifested by "sluggishness of association and impairment of attention contrasting with intact orientation and perfect lucidity. In the emotional sphere there are indifference and atrophy of the moral sense. All aspirations of the patient reduce themselves to a single idea, that of procuring morphine by any possible means; disregard for conventionalities, swindling, falsehoods, violence, all seem to him permissible." There is always a loss of will power. "The patient is conscious of the ruinous results of his inactivity, but has not the power to overcome it. This symptom appears early and, together with the indifference, forms a characteristic feature of the mental state in morphinomania."

If the morphinist is adequately nourished, permanent physical changes are reduced to a minimum. There is always a tendency for the general nutrition to suffer. There may be pallor, loss of flesh, muscular weakness, and gastrointestinal disturbances. Early fatigue prevents strenuous physical exertion. If the addict spends his money for morphine instead of food, as is often the case, he suffers from malnutrition and falls easy prey to tuberculosis and intercurrent infections.

Fear of the day when he will be unable to obtain a supply of his drug is a constant obsession because of the distressing symptoms of abstinence. "When the hour for his injection has passed the morphinomaniac becomes restless, his expression becomes anxious and his respiration accelerated. A state of *anxiety* soon appears, accompanied by a very marked inhibition of all the psychic functions. The patient abandons his unfinished work or conversation and leaves, complaining that he is unable to bear the tortures of which he is a victim. At the same time there is the appearance of the pathognomonic *somatic symptoms*: extreme pallor of the face, acceleration and weakening of the pulse, general prostration, cold sweats, and spells of yawning." Painful muscle cramps in the legs and abdomen are prominent features. If abstinence continues the condition may become alarming; circulatory collapse is threatened which may terminate fatally.

No matter how grave the symptoms or signs become, an injection of morphine nearly always affords instantaneous relief.

"Occasionally the mental symptoms present all the features of an acute psychosis: agitation, anxiety, persecutory ideas, psycho-sensory disorders, excitement simulating that of mania; these may be associated with hysteriform or epileptiform attacks."

Do we know why addiction occurs? Frankly, this question must be answered in the negative. We know certain facts, however, which appear to be basic enough to warrant consideration. It is true that the changes produced by these drugs are primarily in the nervous system. Individuals who are adequately nourished during their addiction commonly maintain their weight and show little physical debility.

It has been stated that the abstinence symptoms of withdrawal are simply psychic manifestations resulting from frustration, and that there is no such thing as a basic physiologic readjustment which occurs following the prolonged use of these compounds. It is exceedingly difficult to explain, on such a basis, the occurrence of the characteristic physical signs of abstinence observed in the rat, rabbit, dog, monkey, or the infant addicted congenitally in utero, or during its first days of life.

Many investigations have been made in an attempt to elucidate the mechanism of addiction. Nearly every concept known to medicine has been invoked to explain it, from Ehrlich's doctrines of immunity to the present-day concepts of autonomic nervous system imbalance based upon chemical mediators of the nerve impulse. None are generally accepted or, in fact, satisfactory.

Certain facts, obtained both from laboratory and clinical studies, are useful in understanding the problems yet to be solved. These must be recognized and serve as a basis for subsequent analysis. It is fortunate that the condition can be reproduced in the laboratory animal. Unquestionably, the most satisfactory animal to study in this regard is the monkey. The complete physical picture of morphine addiction may be reproduced in this animal.⁴ Because of the anatomic similarity to man, the signs of withdrawal in the monkey are the counterpart of those seen in the human addict. If heroin is used as the drug of addiction, all of the essential features of addiction as they apply to man may be reproduced in this animal, including an elevation of the lethal dose by repeated administration.

The known facts are these: The cells, or reflex centers, of the central nervous system when repeatedly exposed to a drug of addiction become increasingly irritable. This is true whether the drug of addiction is primarily a depressant or essentially a stimulant. This new and elevated level of irritability results in an increased tolerance to depressant drugs and a decreased tolerance to stimulant drugs. In the case of the depressants the new level of irritability manifests itself only when an insufficient dose is administered or when the drug is withdrawn, whereas with stimulants it is apparent, to an appreciable extent, only during the exhibition of the drug.

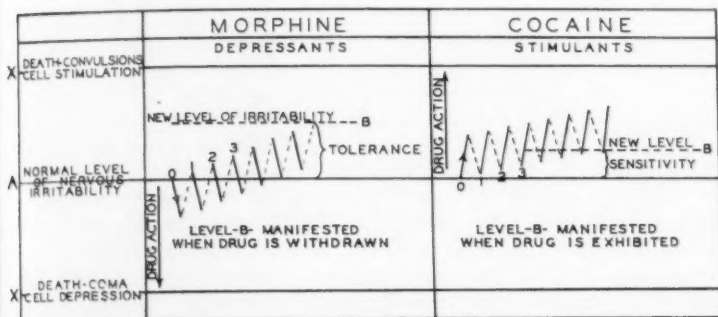


FIG. 1. Graphic representation of phenomena resulting from increase in nervous irritability produced by morphine and cocaine during addiction to these drugs. A. Normal level of nervous excitability. B. New and increased level of irritability following chronic poisoning. 0, 1, 2, 3, etc., may be considered to represent days, weeks, months, or years. Unbroken lines represent drug action, the arrow indicating type of effect (the length of this line could represent dosage of drug). Broken lines represent the recovery phase and show gradual establishment of new level of excitability. The distance between horizontal lines A and B is a function of dosage and time. With depressants, AB indicates degree of acquired tolerance to the drug of addiction and other depressants as well as the degree of acquired sensitivity to stimulants. The severity of the signs and symptoms of abstinence parallels distance AB. With stimulants, AB indicates degree of sensitivity to the drug of addiction or other stimulants and also the degree of tolerance to depressants.

An attempt has been made to graphically portray these changes in the accompanying diagram. Let us consider morphine as a representative of the depressant group. Its immediate action is to depress the level of nervous irritability below the normal level. As its depressant effects subside an over-riding occurs. Each succeeding dose finds a new and higher level of irritability of the nervous system, the result being that after many administrations the initial dose will barely reduce the irritability to its original level. Much larger doses are now required to produce a significant depression. The individual has acquired a marked tolerance for the drug; in fact, he may now take amounts that would have been lethal at first administration. That this acquired tolerance is of a functional nature is indicated by the rapidity with

which it is lost. Within seventy-two hours, a dose of morphine equal in size to the last one administered, may be fatal. A certain mortality occurs among addicts who fail to heed this fact. This acquired tolerance exists not only for the original drug of addiction, but a crossed tolerance is present for other derivatives of opium as well as for other depressants even though they may be chemically dissimilar. This change in irritability is, then, in a certain measure at least, non-specific. This new level of irritability manifests itself in the signs and symptoms of abstinence when the drug is withdrawn. During this period the subject is not only tolerant to depressants but also more susceptible to stimulants, as indicated by the reduction in the quantity of a stimulant drug which is required to kill in convulsions.⁵

With stimulant drugs such as cocaine, similar changes take place but are manifested in a different manner.⁶ In this instance the immediate pharmacologic action of the drug is to elevate rather than depress the level of irritability. Each succeeding administration finds a new and higher level from which to start, much in the same manner as with morphine although the increment is not so great. The fundamental difference is that each succeeding dose of cocaine fails to find a state of tolerance to its action, the result being a greater response of a stimulant nature. A state of sensitivity to the drug has developed. In this instance the new level of irritability is manifested primarily when the drug is administered by an additive effect. The cocaine addict, fearful of this exaggerated effect as addiction progresses, commonly employs some depressant to counterbalance the overstimulation produced by his dose of cocaine. As in the case of the depressants, the new level of irritability is apparent, but to a lesser degree, in the increased tolerance of the individual to depressants and a decreased tolerance to other stimulants.

It must be pointed out that these statements refer only to the fundamental state of irritability of the nervous system as a whole, and particularly with regard to the response of the nerve cells or reflex centers to the drug of addiction and other drugs. This new level of irritability cannot be completely correlated with the subjective sensations of the patient. For example, in both morphinism and cocaineism the individual may be subjectively depressed, although the irritability of his nervous system as a whole, particularly the motor and autonomic components, is increased. The subjective depression may well be an expression of fatigue. Certainly, it does not represent the condition of those centers in the brain responsible for motor and autonomic function.

These considerations obviously do not offer an explanation for the change in nervous irritability which occurs in addiction, but merely describe an end result in an orderly fashion. In reality, the functional state of the nervous system has been biologically assayed by its response to other drugs.

One general statement seems possible from a consideration of these facts. It appears that either the nerve cell, the reflex centers, or the central nervous system as a whole, responds by an increase in irritability to prolonged use of either depressants or stimulants. This means that tolerance is developed only to substances which decrease nervous activity and that there is a decrease in tolerance or an acquired sensitivity to those compounds which increase its activity. Whether this generalization may be applied to all cells is not known.

at present. It is conceivable that some fundamental metabolic change occurs within the cell in response to any of these drugs and the non-specific increase in irritability is a manifestation of this change.

Are there any organic and hence demonstrable changes which occur in the brain during addiction or withdrawal? No characteristic morphologic changes are present, as determined by ordinary histologic methods. Changes are present, to be sure, but as yet they have not been differentiated from those which result from many debilitating states or chronic diseases.

During withdrawal, certain physiologic changes are observed: (a) A blood concentration occurs. This may be due, in part, to a restricted water intake or to a movement of water into the tissues. The brain, for example, acquires more water (similar to the state in chronic alcoholism) and this factor may be partially responsible for the increase in nervous irritability. (b) A greater oxygen unsaturation of venous blood occurs, due largely to the peripheral constriction of blood vessels, the latter a manifestation of the increase in activity of the autonomic nervous system. (c) There is an increased sensitivity to oxygen lack. It is of interest that the symptoms and signs of withdrawal are in many respects very similar to those occurring during inadequate acclimatization to high altitudes or exposure to low oxygen pressures. This might suggest that vascular changes occur in the brain which prevent proper oxygenation, or that these drugs interfere with certain enzyme systems in nerve tissue.

These, then, are the principal physical findings of a positive nature. Meager? Yes! It is unnecessary to list here the negative findings.

Can we learn anything about the condition by the response of the addict to treatment? Can an addict be cured? Brain dehydration tends to reduce the signs and symptoms of irritability. The inhalation of oxygen gives some benefit. Replacement of the drug of addiction with other depressant drugs during abstinence sometimes relieves the distress of withdrawal. But none of these types of treatment is specific and the response to therapy is notably unsatisfactory. Complete physical rehabilitation is possible in most cases if the drug is withdrawn. Psychic or mental rehabilitation is rare. Relatively few addicts of long standing remain away from the drug permanently. They never forget the honeymoon stage of morphinism and commonly succumb in a moment of weakness. In fact, the vicious commonly take the cure in order to begin again as novices, since as addiction progresses, larger and larger doses are required to prevent the symptoms of abstinence, and the euphoria which was obtained in the initial stages of addiction is now of very short duration, or may be completely lost.

Is there any hope of solution of these problems either from a medical or social viewpoint? Several possibilities suggest themselves.

Control of production of the compounds responsible for addiction by international agencies. Whereas this appears to be the only ultimate solution of the problem, the profits derived by the responsible nations from the exploitation of these drugs are so large as to be an effective stumbling block to any action except periodic conferences and paper agreements.

Control by National or State legislation is impossible in the absence of international control because of the ease with which smuggling of these compact

drugs can be accomplished. Mere mention of the Volstead Act fiasco is sufficient to prove this point.

An elucidation of the mechanisms of addiction would extend the possibilities of treatment but have little influence upon the incidence of addiction.

The discovery of new pain-relieving drugs to replace the opiates would obviate those cases of addiction resulting from therapy. A thorough search for such compounds is being conducted at present by the combined efforts of the Bureau of Social Hygiene, The National Research Council, the United States Public Health Service, and the Universities of Michigan and Virginia. Even if such a compound were to be found, control would not be effective unless the production of the present drugs was curtailed.

In view of the fact that little apparent progress is being made toward a solution of the problem on any of these fronts, would it be out of place to suggest that an intelligent and unemotional program of education concerning the facts of addiction might be a worthwhile venture even if it reached only the thinking people of this nation.

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Nutrition and Human Welfare

(Concluded from page 90)

In drawing this talk to a close I should point out that enthusiasm regarding the contributions of nutrition must not cause us to forget that many other factors, such as heredity and infectious diseases are vitally concerned in productive life. In fact, I should perhaps recall what I said at the start regarding the overexploitations of nutrition discoveries. The history of the recent research reveals many errors, as well as triumphs, emphasizing the need for the curtailment of premature conclusions and an expansion of more critical, long-time studies. If a field of research has large possibilities of improving human welfare, it may have equal possibilities for harm if the conclusions are wrong. This fact has not always been sufficiently recognized by the nutrition worker.

Perhaps I have been overenthusiastic regarding longevity studies, for according to Lucretius: "Verily, a sure end of life is ordained for mortals, nor can we avoid death, but we must meet it."—"Nor in truth by prolonging life do we take away a jot from the time of death, nor can we subtract anything whereby we may be perchance less long dead." Nevertheless, the problem of getting the most out of life while it lasts seems a worthwhile one, a fascinating field, demanding the best which science has to offer, worthy of the ideals of Sigma Xi.

NEWFOUNDLAND: GEOLOGY AND PEOPLES

W. H. TWENHOFEL

INTRODUCTION

Newfoundland includes parts of three great orographic provinces of North America. Southeastern Newfoundland, the Avalon peninsula with some of the adjacent areas to the west, is a part of the ancient Acadian geosyncline, a more or less submerged basin of the early Paleozoic and pre-Cambrian periods in which were accumulated vast thicknesses of sediments. This basin extended southwest to beyond Rhode Island and northeast for an unknown distance into what is now the North Atlantic Ocean. The western half of Newfoundland is a part of the great Appalachian geosyncline, an ancient basin that once extended northeastward to beyond the Strait of Belle Isle and southwestward to beyond Alabama. The northern end of this basin is known as the St. Lawrence geosyncline. These two basins were separated by the New Brunswick geanticline, an upland area of folded ancient rocks that extended far to the northeast and southwest to beyond New England. This area was often of a mountainous character. West and northwest of the St. Lawrence Geosyncline was the Canadian Shield or Laurentia, a broad upland area extending westward to beyond what is now Hudson Bay. Bounding the Acadian geosyncline on the east and southeast was the borderland of Novascotica, eastward of which, perhaps, lay the ancient Atlantic Ocean. Except for a fragment in Nova Scotia, Novascotica now lies submerged beneath the Atlantic.

The history of each of these orographic provinces carries back to beyond a billion years. The geosynclines were repeatedly submerged beneath the waters of the sea and as often were lowland areas above the sea. Laurentia, the New Brunswick geanticline, and Novascotica were rarely under water, and these lands supplied the sediments which were deposited in the geosynclines. The five provinces are shown in figure 1. The geologic column is shown in Table 1.

TABLE 1

THE GEOLOGIC COLUMN

Cenozoic Era
Recent Period
Pleistocene Period
Tertiary Period
Mesozoic Era
Cretaceous Period
Jurassic Period
Triassic Period
Paleozoic Era
Permian Period
Pennsylvanian Period
Mississippian Period
Devonian Period
Silurian Period
Ordovician Period
Cambrian Period
Pre-Cambrian Eras

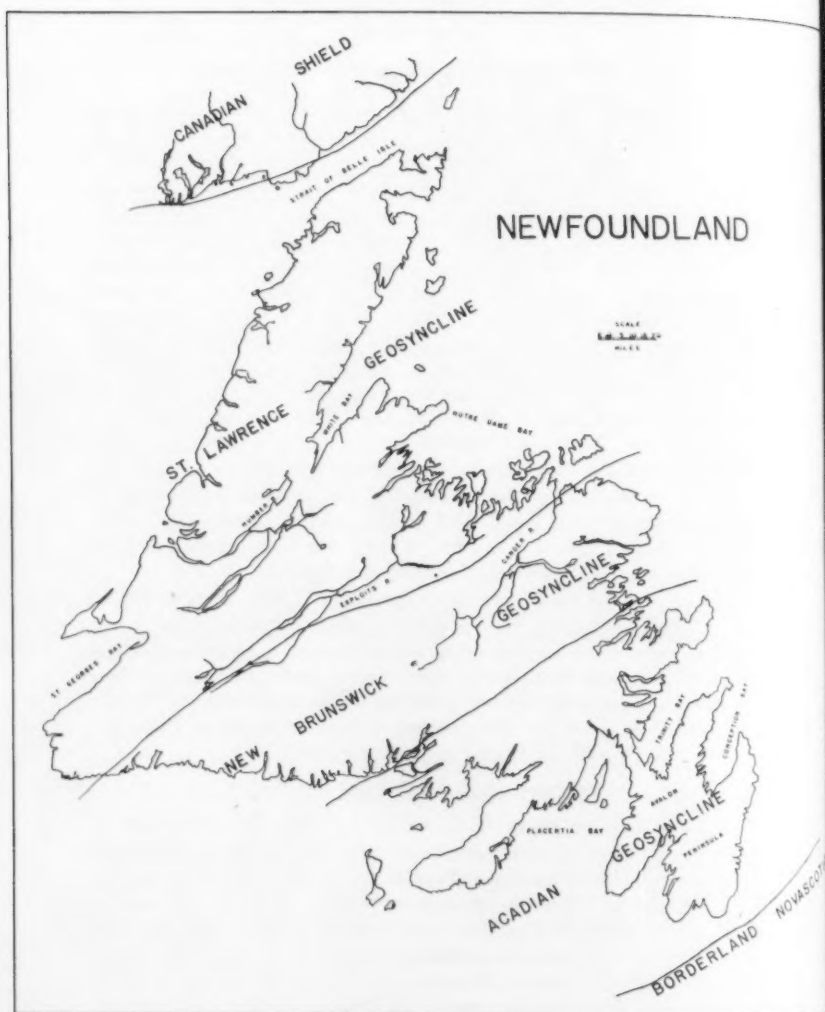


FIG. 1. Map showing the orographic provinces which are connected with the geologic history of Newfoundland.

THE ACADIAN GEOSYNCLINE

At times the Acadian geosyncline was more or less submerged beneath the waters of the early seas and at other times it was a river valley or a coastal plain. It received sediments from the bordering lands of Novascotica and the

New Brunswick geanticline. These lands seem to have been high during much of the pre-Cambrian, relatively low during the Cambrian, and the New Brunswick geanticline is known to have been elevated during the Ordovician and Silurian.

Sediments deposited in the Acadian geosyncline are not now completely shown in Newfoundland and many of those probably once present have been removed by erosion. They are much better preserved a short distance to the southwest in Nova Scotia and still farther to the southwest in Maine, eastern Massachusetts, and Rhode Island. It is known that sediments were deposited in the Acadian geosyncline during the pre-Cambrian, Ordovician, Silurian, and Devonian periods, but only pre-Cambrian and Ordovician sediments are preserved in the Newfoundland part of the basin.

The pre-Cambrian sediments of the Acadian geosyncline are best known in Nova Scotia where there are over 35,000 feet of plastic sediments of which the Goldenville formation at the base is composed of quartzite with a thickness of nearly 24,000 feet and the top is the Halifax formation of nearly 12,000 feet of slate. There are 26,000 feet of pre-Cambrian slate, quartzite, and conglomerate on the Avalon Peninsula and these overlie a great thickness of volcanics.

Following the pre-Cambrian there was a long interval when the Newfoundland part of the geosyncline was above sea level and subject to the agents of erosion. The bounding highland areas were being eroded at the same time so that a deeply eroded surface was in existence at the beginning of Lower Cambrian submergence. The places of deposition of the sediments derived from this erosion are not known.

Cambrian sediments were more or less generally deposited throughout Acadian geosyncline and in Newfoundland they consist of limestone and shale with thickness of only about 1000 feet. All three divisions of the Cambrian are present. There seems to have been emergence of the geosyncline at the close of the Cambrian period and also uplift of the New Brunswick geanticline and, perhaps Nova Scotia. The Cambrian strata are fossiliferous and the organisms are different from those in the not far distant St. Lawrence geosyncline. There are few common species, and it is obvious the New Brunswick geanticline rather completely separated the two basins.

The Acadian geosyncline was again submerged in the early part of the Ordovician period and mud and sand to the thickness of about 9000 feet were washed into the Newfoundland part of the basin. In the region of what is now Conception Bay conditions existed that several times made possible deposition of iron oxide in the form of small spherical and ellipsoidal particles with concentric structure like that in an onion. These particles are about the dimensions of fish roe and are known as oolites. These now form the Wabana hematite deposit of Bell Island in Conception Bay, one of the most valuable mineral resources of Newfoundland. It seems probable that during the later two-thirds of the Ordovician period the Newfoundland part of the geosyncline was not submerged, as no Middle and Upper Ordovician strata are known to have been deposited. The Ordovician strata are not very fossiliferous and evidently conditions on the sea bottom were not favorable for marine organisms.

No strata younger than the Lower Ordovician are known in the Newfoundland part of the Acadian geosyncline, but at Arisaig, Nova Scotia, a short distance to the southwest, over 3000 feet of Silurian were deposited. The lower half consists of shale and the upper half of impure limestone. At Eastport, Maine, there are between three and four miles of Silurian rocks of which more than half consists of various kinds of volcanics, proving intense volcanic activity in that region during the Silurian. It is not improbable that Silurian strata not greatly unlike those of Nova Scotia were once present in southeastern Newfoundland. The Silurian strata of Nova Scotia and Maine are filled with fossils and the assemblages are altogether unlike those of the Appalachian geosyncline. Only a few species of wide geographical distribution are common to the two basins.

The close of the Silurian again witnessed emergence of the Acadian geosyncline. Deposition of Devonian continental sediments in northern Nova Scotia followed this emergence. Deposition of similar sediments may have obtained in Newfoundland; but, if such was the case, these were later removed by erosion.

The Acadian geosyncline was in the throes of great earth movement in the Middle Devonian. The rocks were more or less greatly deformed and the geosyncline was elevated into mountains and disappeared as a basin. There was much igneous activity and the granite masses of southern Nova Scotia are believed to have been intruded at this time. This uplift initiated erosion, which may not have been interrupted until the submergence following the last ice age.

THE ST. LAWRENCE GEOSYNCLINE

Not a great deal is known of the pre-Cambrian rocks of the Newfoundland part of the St. Lawrence geosyncline. The beginning of the Cambrian found the pre-Cambrian rocks deeply eroded and where the base of the Cambrian strata has been seen in contact with the pre-Cambrian, the latter rocks show by their characters that they were once deep beneath the surface of the earth. The characters of the surface upon which the Cambrian sediments were deposited is not known, but available evidence indicates that it was a plain of no great relief. There are three Lower Cambrian formations in northwestern Newfoundland. The initial lower Cambrian sediments form the Brador formation which consists of more or less coarse sandstone with a thickness of 220 to 285 feet. This is succeeded by the Forteau formation of reef-like limestone formed from the skeletal structures of peculiar sponge- or coral-like animals known as the *Archaeocyathinae*. These have no living representatives. The Forteau formation ranges in thickness from 185 to 385 feet. The top of the Lower Cambrian is the Hawke Bay formation. This is composed of quartzite with a thickness of 350 feet. The Lower Cambrian is also exposed about the middle of the west coast of Newfoundland in Bonne Bay where it has a thickness of at least 2200 feet with the base not shown. The strata consist of shale, sandstone, and a little limestone. *Archaeocyathinae* are not known in the Bonne Bay strata. Either they did not live in that part of the Lower Cambrian sea or the containing strata lie below those exposed.

The Newfoundland part of the St. Lawrence geosyncline underwent some submergence in the Middle Cambrian and again in the Upper Cambrian as

strata of these intervals are in place on the south side of Cape St. George, where they constitute the March Point formation which consists of 350 feet of sandstone followed upward in succession by 200 feet of shale, 300 feet of dolomite of which some is oolitic, and 80 feet of siltstone and thick-bedded limestone. No Middle Cambrian is known in northern or northwestern Newfoundland and Upper Cambrian is not known in place, but numerous large boulders in the Middle Ordovician Cow Head breccia prove that it once was present.

The Ordovician of the St. Lawrence geosyncline of Newfoundland represents the lower half to two-thirds of the system. The section west of the Long Range is very thick and consists in ascending order of the Green Point series of shale and sandstone with a thickness of more than 1700 feet, St. George series of dolomite and fine-grained sandstone with thickness exceeding 2000 feet, Table Head series consisting of 1380 feet of limestone passing upward into black shale, Long Point series of 1530 feet of shale and limestone and Humber Arm series of shale and sandstone with the very coarse and thick Cow Head breccia at the base. The thickness of the Humber Arm series is at least 5000 feet and it may be 10,000 feet. There are blocks in the Cow Head breccia with lengths of 600 feet. The great thickness of sandstone and shale of the Humber Arm series and the enormous size of the blocks in the Cow Head breccia prove uplift beginning in the Middle Ordovician. Steep slopes must have existed adjacent to the sites of deposition of the breccia as many of the blocks must have slid directly into the sea.

There are great thicknesses of Ordovician strata on the west side of the Long Range in White and Notre Dame bays. Those in White Bay consist of shale and sandstone containing few fossils for which the metamorphism they have experienced may be held largely responsible. There are more than 10,000 feet of clastics with a little limestone and much contemporaneous volcanic material in Notre Dame Bay. The section in Notre Dame Bay contains more than 2000 feet of conglomerate.

The great thickness of clastics in the Ordovician of Notre Dame and White bays and the great thickness in the Acadian geosyncline shows that the New Brunswick geanticline had been uplifted before or in the early Ordovician. As this geanticline is not more than 100 miles across and the sediments contain much coarse material, it indicates that relatively high lands existed there, or the geanticline was repeatedly uplifted. Elevation spread westward in the Middle Ordovician to include parts of Western Newfoundland. The Canadian Shield was not elevated as the Ordovician sediments adjacent thereto show little in the way of clastic sediments and on Anticosti Island the late Ordovician calcareous strata pass into the early Silurian calcareous strata without much change in lithology.

Parts of the Ordovician strata of western Newfoundland are filled with fossils. These have a community of character with fossils of contemporaneous strata in the southwestern continuation of the St. Lawrence geosyncline. There are few fossils in the strata of northern Newfoundland.

No Upper Ordovician is known in western Newfoundland, although present in excellent development on Anticosti Island, a couple of hundred miles to the west. The Newfoundland region seems to have been above sea level.

Submergence again began early in the Silurian. This is not shown on the west coast of Newfoundland as no Silurian is present there, but is proven by the presence of over a mile of Silurian clastics in White and Notre Dame bays. About 1000 feet of conglomerate are present at the base of the Silurian section of Notre Dame Bay. This great thickness of clastics denotes uplift of the New Brunswick geanticline. Only the lower third of the Silurian is present on Newfoundland, and it is believed that the Newfoundland part of the St. Lawrence geosyncline was not submerged during Middle and Upper Silurian. Fossils are not abundant in the Silurian strata, which may, in part, be explained as due to the metamorphism the strata have experienced, but seems to be mainly due to the conditions of the bottom of the Silurian sea not having been favorable for marine organisms. The fossils are like those of other parts of the St. Lawrence geosyncline and are very unlike those in the Silurian of the Acadian geosyncline as shown at Arisaig, Nova Scotia.

Western Newfoundland was again submerged for a short time in the early Devonian, as Devonian strata, designated the Clam Bank formation, are known at Long Point on Port au Port Bay. There are at least 1700 feet of sandstone and conglomerate containing Lower Devonian fossils. As the strata of the Clam Bank formation are those of shallow water near shore, the implication is that Devonian submergence of western Newfoundland was not extensive.

The Mississippian system is represented in western Newfoundland by the Windsor series with basic intrusives. The ascending sequence consists of 1300 feet of conglomerate, 150 feet of anhydrite with some thin limestone and 2000 feet of shale and sandstone with some thin limestone. Much of the section is non-marine and the sediments were deposited on river plains and deltas. Following the Mississippian a land interval began which endured until the partial submergence following the Ice Age. An early expression of the emergence is the presence in western Newfoundland of at least 3000 feet of Pennsylvanian sandstone with some coal. The Pennsylvanian strata were not deposited in the sea.

The latest strata were deposited during and shortly after the Ice Age. These consist of various varieties of glacial and fluvio-glacial deposits and some marine strata deposited in the partial submergence that followed the Ice Age.

NEWFOUNDLAND OROGENY

Paleozoic orogeny was initiated in northeastern North America in the early Ordovician and with some interruptions endured for more than 200,000,000 years. The beginning is expressed in western Newfoundland in the thick Humber Arm sandstone and shale with the remarkable Cow Head breccia at the base and in northern Newfoundland in the great thickness of Ordovician clastics in White and Notre Dame bays with the many thick zones of conglomerate in Notre Dame Bay. The Cow Head breccia has been shown by Schuchert and Dunbar to have been formed by rock fragments sliding to the sites of deposition from an overriding thrust block that was moving westward over an eastward dipping fault plane. Early Ordovician movement is also shown in the great thickness of early Ordovician clastics in the Acadian geosyncline. The Ordovician strata of the west coast are more deformed than

those of the succeeding Devonian (Schuchert and Dunbar, 1906), thus proving deformation in late Ordovician or Silurian. Orogeny continued during the deposition of the early Silurian strata of White and Notre Dame bays, following which uplift of the Newfoundland part of the St. Lawrence geosyncline took place and presumably of the Acadian geosyncline, but as that geosyncline contains no sediments younger than the early Ordovician precise dating is not possible. Late Silurian elevation, but not necessarily deformation of the regions of supply of sediments, is indicated by the clastics of the Devonian Clam Bank formation. To the southwest in Nova Scotia and on the Peninsula of Gaspe it is known that severe deformation accompanied by intense volcanic activity and great outpouring and intrusion of lava began in Middle Devonian. It is not certain that this deformation is expressed in Newfoundland. Some time following the early Silurian, northern Newfoundland was intensely deformed and in White and Notre Dame bays there was much volcanic and intrusive activity. Metamorphism was locally very severe and over wide areas shales were changed to slates, sandstones to quartzites, and conglomerates to conglomerites. The strata of White and Notre Dame bays were bent into overturned folds and sliced by great overthrust faults, with the blocks forced northwestward over southeastwardly dipping fault planes. There is no way of dating these movements in Notre Dame Bay other than that they are post early Silurian, and probably pre-Pennsylvanian. It is possible that the movement in White Bay geology is understood, but the writer is inclined to the view that no inconsiderable part of the Middle Paleozoic deformative movement in the St. Lawrence geosyncline took place toward the close of the Silurian and correlates with the Late Silurian Caledonian deformation of northwestern Europe and not with the Middle Devonian deformation so excellently shown in Nova Scotia.

The last great orogenic movement to which Newfoundland was subjected is that which took place toward the close of the Paleozoic in what is known as the Appalachian Revolution. This movement is known to have affected Newfoundland as Mississippian and Pennsylvanian strata are deformed, but the deformation does not seem to be so intense as that of the Silurian and older strata. Except locally, folding of the post-Silurian strata is not decided, but there are places where the strata are sharply folded and inclinations tend to be very high. There was both overthrust and normal faulting and the Long Range is known to have been faulted over Carboniferous strata. It is possible, but not considered probable, that the thrust faulting and overturned folding so strongly developed in the Notre Dame Bay region were made at this time. It may be that the faults cutting post-Silurian strata were developed in the Caledonian or Acadian deformation and experienced renewed movement in late Paleozoic.

The great folds and thrust faults of the several orogenies led to much shortening of the width of Newfoundland in a somewhat northwest-southeast direction. The extent of the shortening can merely be conjectured, but many tens of miles may reasonably be assumed. The deformation also developed northeasterly-southwesterly lines of erosive weakness which in course of time became expressed in the character of the surface.

THE GREAT EROSION INTERVAL

Newfoundland seems to have been above the sea from the late Paleozoic to the close of the Ice Age. This is an interval approximating 100,000,000 years. The fold and fault mountains made by the several orogenies probably disappeared very early and nothing now remains to show their one time presence except the folded and faulted strata and the great thicknesses of clastic sediments shown in the many coastal exposures. It is probable that there were subsequent vertical uplifts such as are known to have occurred in the extensions of the orographic provinces to the south and west. There were as many intervals of erosion. The result was the Newfoundland of the Tertiary when the land is thought to have been a low plain—a peneplane—with river direction controlled by structure and previous history.

CHARACTER OF SURFACE

If one observes Newfoundland on a map he cannot fail to be impressed with the deep salients and long peninsulas. With few exceptions (the Bay of Islands and Bonne Bay are the most conspicuous) the deep indentations and long peninsulas have northeastwardly-southwestwardly trends. These are the trends of folding and faulting and, as always, erosion is greatest along weak belts and the belts of strong rocks remain as ridges. The greatest agent of erosion is running water and the depressions of the present deep bays were carved by this agent. These were once the lower parts of river valleys that are now drowned. This indicates that submergence took place in the not far distant past. If one examines the sides of the bays he may find shelves or terraces along them. These mark former levels of the sea and show that Newfoundland was once more deeply submerged than now and has been rising in the latest geologic period.

If one takes a journey across Newfoundland on the Newfoundland Railways and boards the train at Port aux Basques, a fishing village on the southwestern end of the Long Range, he travels in the beginning through mountains. Observation readily shows that the tops of the mountains rise to about a common level and many have flat tops. The railroad cuts show that the rocks are greatly folded and of complex structure. After some travel through the mountains the railroad leaves them and follows a coastal lowland to St. George Bay. The mountains of the Long Range rise like a wall on the east side of this plain and canyons permit one to look into them for considerable distances. One is impressed by their ruggedness.

The mountain wall is offset at St. George Bay by what is evidently a great fault. The train may be left about half way from Port aux Basques to St. George Bay and the mountains climbed. A different picture is presented. The observer finds himself standing on the surface of a gently rolling plain that extends far to the east. The mountains should again be climbed at Port aux Basques and there it will also be seen that the tops of the mountains are nearly a plain. The railroad leaves the coastal plain at St. George Bay and follows a valley into the interior, crosses a divide and enters the drainage area of the Bay of Islands, one of the few indentations not controlled by the general structure. This is the outlet of the Humber River. This river rises on the

east side of the Long Range west of the head of White Bay and cuts through the Long Range in a magnificent gorge of which the lower forty miles are drowned. The region of the Bay of Islands is mountainous, but the mountains have flat tops. A trip should be made to Bonne Bay and Table Mountain climbed. This is a flat-topped remnant of the plain which was separated from it by erosion. The railroad follows the Humber River to the head of Deer Lake, thence a tributary of the Humber to the upland plain and thence with only very shallow cuts and low fills it crosses an almost level plain for many miles. A few remnants of erosion in the form of rounded hills, of which those known as the Topsails are the most conspicuous, rise from this plain. This is one of the most remarkable upland plains the writer has ever seen. It was carved in the long interval that lasted through the Triassic, Jurassic, Cretaceous and probably a part of the Tertiary periods. At the time of completion of this plain, either in late Cretaceous or some time in the Tertiary, Newfoundland was a flat area with the seaward margins at the level of the sea. The only hills were rounded remnants of erosion. It was on this plain that the major and probably most of the minor streams acquired their present courses. The Gander, Exploits and most streams flowed in accordance with the structure, but the Humber River flowed to the west with its upper reaches in accordance with the structure, but its lower reaches across the structure. Vertical uplift accompanied by tilting took place in middle or later Tertiary. The northwestern margin of the plain was raised more than 2000 feet, the northeast about 700 feet. The streams entrenched themselves in inherited courses. Streams draining westward found themselves in difficulty, but the Humber and the stream draining the Bonne Bay region cut downward as rapidly as the lands were elevated and carved deep gorges in so doing. The entrenchment was naturally most pronounced adjacent to the sea. Then came the Ice Age and most, if not all, of Newfoundland was covered with an ice sheet. Plants of ancient lineage in the Long Range have been interpreted as indicating unglaciated areas. This may well be so, but more study is required. The last glaciation of Newfoundland—there probably were earlier ones—is considered by the writer to correlate with the Wisconsin advance. Some 25,000 to 50,000 years ago the ice disappeared and there followed some submergence of Newfoundland which drowned the lower reaches of the valleys, thus creating the deep indentations and the long salients. The land has since risen to some extent and is said now to be rising north of a line extending from St. George to Bonavista Bay and subsiding to the south of this line.

The ice sheets nearly deprived Newfoundland of soil and large areas are bare rock surface or rock covered with thin accumulations of peat. Large and small erratics are very abundant. The ice sheets also excavated basins and placed glacial deposits across depressions. There are now sites of lakes.

PEOPLE, INDUSTRIES, AND SCENERY

Except for St. Johns and settlements in connection with mines, pulp manufacture and hydroelectric plants connected with the pulp industry, most people live in small villages on the coasts where deep bays provide safe anchorage for boats used in the fishing industry, and a small settlement may be found near the head of every protected bay. Except for the west half of the south shore,

the so-called French shore, and a few other places, the people are of English origin. There is a small admixture of Micmac Indian blood on the east side of White Bay. The people with whom the writer is familiar are genial, hospitable and industrious. The fishermen are excellent carpenters, mechanics and general handymen with tools. They construct their boats, houses, and much of their furniture and tools. They are tremendously handicapped by the climatic and geologic conditions, and for many years have been exploited by politicians.

Fishing is the chief industry, and it is a hazardous occupation from both the physical and economic points of view. The fish do not always run and due to conditions in the areas of market in Europe and elsewhere, outlet for the catch has been curtailed and this has brought hardship to many.

Agriculture is poorly developed but could be extended and improved. This is one of the objectives of the present Commission Government of the island. The areas available for cultivation about many of the fishing villages are pitifully small and in many places the areas of cultivatable land are inadequate for the needs of the population. Pasture lands could be enlarged with ease about most settlements and more hay could be raised than is. There are many tens of thousands of acres in the interior where no agriculture of any kind is possible.

The pulp industry is important and two companies are developing the pulp resources of the island. The International Power and Paper Company has a factory and hydroelectric plants in the Bay of Islands and on the Humber River and the Anglo-Newfoundland Development Company has plants at Grand and Bishops falls on the Exploits River. Under proper development this industry should be a continuing one and under proper regulation should serve as a continuing outlet for winter labor for the fishermen.

The mineral resources are mainly in prospect but prospects are extensive. The Wabana iron ores of Bell Island in Conception Bay are excellent and the reserves are considered large. Lead, zinc, and copper ore are mined in the Interior of the Island at Buchans on Red Indian Lake. Copper has been mined in the past at several places, but the mines have been abandoned. Fluorspar is mined on the Burin Peninsula of the south coast where Snelgrove states the reserves are large. Many other ore minerals are known but none of them is being mined. There are great deposits of gypsum and anhydrite south of St. George Bay, but the market is too far away to make these worthy of development at the present time. Considerable has been written relating to coal resources, but none is mined. There are immense resources of most excellent building stone, but the market is limited. The mining industry at the present time directly supports a few thousand people.

Newfoundland has wonderful scenery. The cliffed coasts are magnificent but they must be seen from a boat as roads are largely wanting. The ruggedness of the west side of the Long Range and the flatness of the summits present an impressive contrast. The Bay of Islands and Bonne Bay are among the most beautiful fiords in the world and magnificent wooded cliffs rise more than a thousand feet directly from the sea. The numerous islands of the north coast rival imagination and one may cruise among them for days. Dildo Run, a channel in Notre Dame Bay between islands, is said to have an island for every

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THE WEST VIRGINIA INSTALLATION

The installation of the seventy-seventh chapter of the Society of the Sigma Xi, named the West Virginia Chapter, started at 10.00 A.M., March 30, 1939. President Lawall declared a University holiday from 10.00 A.M. to 12.00 noon, so that students, faculty and friends would have the opportunity of attending the morning program.

The morning program was presided over by Dr. Samuel Morris, President of the Sigma Xi Club. The program opened with a twenty-minute concert by the University Glee Club, directed by Professor Frank Cuthbert, head of the School of Music, followed by a short talk by Dr. P. D. Strausbaugh on "The Meaning of Sigma Xi." This part of the program was broadcast over Station WMNN, through which the University broadcasts its various activities.

The main address of the morning was delivered by Professor Douglas Johnson, head of the department of geology at Columbia University. Professor Johnson portrayed the scientific method at work in his address, "The Mysterious Craters Along the Carolina Coast." The address was heard by an appreciative audience which filled Commencement Hall. The skillful manner in which Professor Johnson illustrated the use of the scientific method in investigations gave the audience an insight into the meaning of research and the aim and purposes of the Society.

At 1.00 P.M. the representatives of kindred societies, the members of Sigma Xi, including the national officers, and delegates assembled in the Student Center for luncheon, and a brief program. Dr. P. I. Reed, representing Phi Beta Kappa, Professor G. P. Boomsliker, representing West Virginia Scientific Society, welcomed the new chapter to the campus.

The National President of Sigma Xi, Professor George A. Baitsell of Yale University, spoke concerning "Science in Progress," Sigma Xi's first published volume in science.

The formal installation, at 3.00 P.M., was held in the Court Room of the Law Building. After the call to order by President Morris, Dr. G. S. Dodds presented the National President and the National Secretary as installing officers. The petition for the establishment of a chapter of the Society of the Sigma Xi at West Virginia University was read by Dr. O. Rex Ford, Secretary of the Sigma Xi Club, and the action of the Executive Committee of the National Convention on the petition was announced by Dean Edward Ellery, National Secretray.

Printed copies of the by-laws of the proposed chapter were distributed to members. Professor A. H. Forman, chairman of the committee preparing them, briefly summarized the by-laws. The by-laws were approved as presented.

Dr. L. M. Peairs, chairman of the Nominating Committee, submitted the report of his committee. The report was accepted.

The following officers were elected:

President, Dr. A. M. Reese.

Vice-President, Dr. O. Rex Ford.

Secretary, Dr. C. L. Lazzell.
Treasurer, Professor James H. Gill.

Executive Committee:

To serve for one year, Dr. G. S. Dodds.
To serve for two years, Dr. R. B. Dustman.
To serve for three years, Dr. A. H. Forman.

Membership Committee:

To serve for one year, Dr. Samuel Morris.
To serve for one year, Dr. G. H. Pohlman.
To serve for one year, Professor J. B. Grumbein.
To serve for one year, Prof. Dana Wells.
To serve for two years, Dr. W. A. Koehler.
To serve for two years, Prof. J. H. Reitz.
To serve for two years, Dean Edward VanLiere.
To serve for two years, Dr. F. A. Molby.

The officers were installed by Dean Edward Ellery and the Charter was presented by Professor G. A. Baitzell. Dr. A. M. Reese accepted the Charter from the National Officers and briefly acknowledged its receipt.

The ladies of the Campus Club gave a reception at four o'clock in Elizabeth Moore Hall, honoring the new Chapter of Sigma Xi. In the receiving line were Mrs. Colson, Vice President of the Campus Club, Dr. and Mrs. A. M. Reese, Acting President and Mrs. C. E. Lawall, Professor G. A. Baitzell, Dean Edward Ellery and Dr. Samuel Morris retiring president of the Sigma Xi Club.

The installation program was concluded with a formal banquet in Hotel Morgan at 7:00 P.M. Dr. A. M. Reese, President of the new chapter presided as toastmaster. Addresses of welcome to the new chapter were made by Acting President of the University, C. E. Lawall, and Walter R. Thurmond, President of West Virginia Board of Control. Arthur B. Koontz, President of the Board of Governors was unable to be present, but was represented by Mr. C. T. Neff, Jr., Secretary to the Board of Governors. Response to the welcome was given by National Sigma Xi President, Professor G. A. Baitzell.

Dr. R. C. Colwell, head of Department of Physics, introduced the following representatives:

Professor J. B. Grumbein, Cornell Chapter.
Dr. Leon H. Leonian, Michigan Chapter.
Dr. Julian Leach, Minnesota Chapter.
Dr. George A. Pohlman, Iowa State Chapter.
Professor R. H. Suds, Penn. State Chapter.
Dr. Samuel Aspinall, Swarthmore Chapter.

Other visitors introduced by Dr. Colwell were:

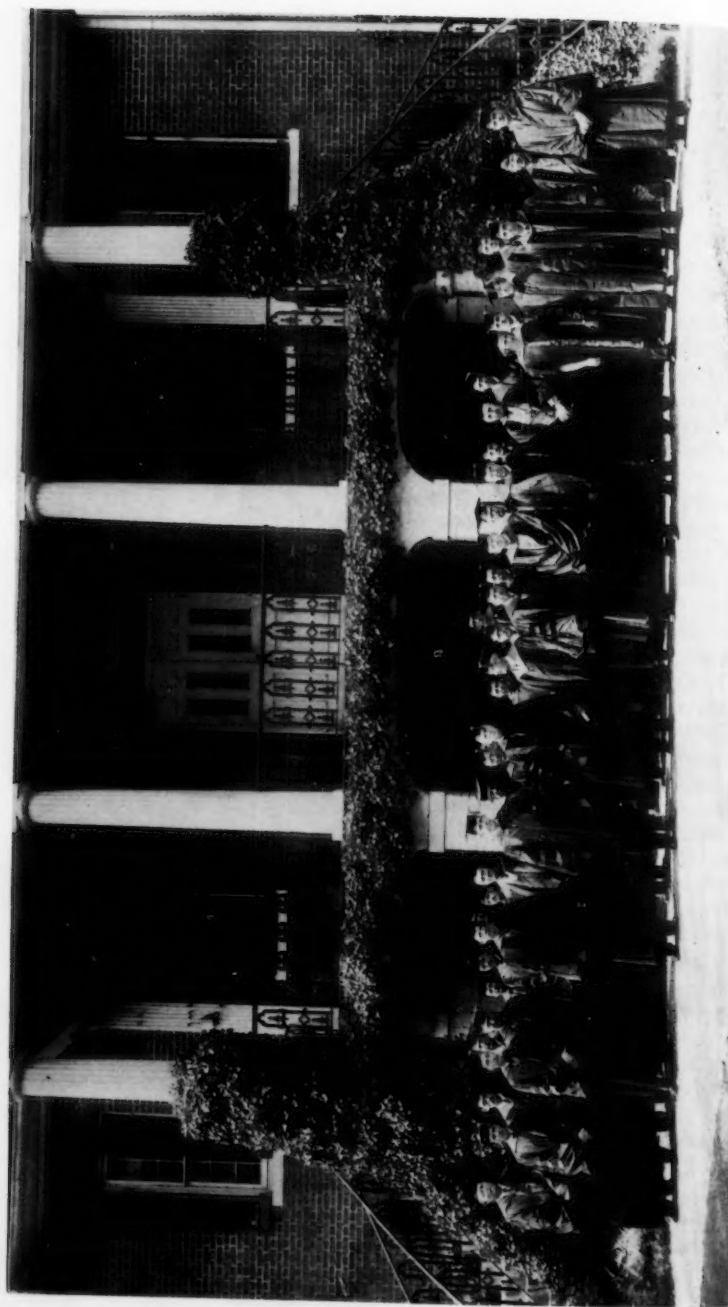
Dean Greenleaf from Marshall College.
Dean B. R. Weimer from Bethany College.
Dr. W. H. Erskine from Bethany College.
Prof. R. P. Ward from Fairmont State Teachers College.

Prof. George R. Hunt from Fairmont State Teachers College.
Dr. Clippinger from Ohio University.
Dr. Frey from Ohio University.
Dr. J. E. Judson from Wesleyan College.
Dr. William A. Mudge, International Nickel Company.

A number of chapters, clubs and individuals sent congratulatory messages. These messages were acknowledged by Dr. C. R. Orton, Dean of the College of Agriculture. They are as follows:

Governor Homer A. Holt, Governor of West Virginia.
President Arthur B. Koontz, Board of Governors.
Washington Chapter of Sigma Xi.
California Chapter of Sigma Xi.
University of Illinois Chapter of Sigma Xi.
Stanford Chapter of Sigma Xi.
Carleton College Chapter of Sigma Xi.
California Institute of Technology Chapter of Sigma Xi.
Northwestern University Chapter of Sigma Xi.
George Washington University Chapter of Sigma Xi.
Columbia Chapter of Sigma Xi.
Rutgers Chapter of Sigma Xi.
Maryland Chapter of Sigma Xi.
Tulane Chapter of Sigma Xi.
Chicago Chapter of Sigma Xi.
Pittsburg Chapter of Sigma Xi.
Oklahoma Chapter of Sigma Xi.
Virginia Chapter of Sigma Xi.
Rochester Chapter of Sigma Xi.
Colorado Chapter of Sigma Xi.
Indiana Chapter of Sigma Xi.
Buffalo Chapter of Sigma Xi.
Connecticut State College Sigma Xi. Club.
Saint Louis University Sigma Xi Club.
University of Florida Sigma Xi Club.
University of California Sigma Xi Club.
Mr. J. H. Edwards, Associate Editor of *Coal Age*.
The American Society of Mechanical Engineers by its Secretary, C. E. Davies.
Dr. R. A. Gortner of the Sigma Xi Executive Committee.
Mr. Harold F. Norton of the Sigma Xi Executive Committee.
Mr. Harold DeWitt Smith of the Sigma Xi Financial Advisory Committee.
Dr. H. G. Knight, of the Sigma Xi Alumni Committee.
President James E. Allen of Marshall College.
Professor Milton Marshall of Brigham Young University at Provo, Utah.
Mr. Roger B. Williams, Jr., of the Sigma Xi Financial Advisory Committee.

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TO FRONT OF THE HOUSE ON THE CAMPUS OF THE UNIVERSITY OF ALABAMA, THE MEMBERS AND GUESTS OF THE ALABAMA CHAPTER OF THE UNITED DAUGHTERS OF THE CONFEDERACY.

MEMBERS AND INSTALLATION GUESTS OF THE ALABAMA CHAPTER
In Front of the House on the Campus of the University at One Time the Home of
Dr. Nathan Crawford, President of the Second National Association of Negro College Graduates

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Southeastern Section American Institute of Mining Engineering	Professor James R. Cudworth, Mining Engineering, University of Alabama.
Alabama Academy of Science	Dr. Septim Smith, Secretary of Alabama Academy of Science, Associate Professor of Biology, University of Alabama
Phi Beta Kappa	Professor E. Baskin Wright, President, Alabama Chapter Phi Beta Kappa, Member of Political Science Department, University of Alabama.
Alpha Epsilon Delta	Mr. Jesse Pugh Chapman, President Alabama Alpha Chapter, Alpha Epsilon Delta, Senior
Gamma Sigma Epsilon	Mr. W. J. Worthington, Jr., President Alabama Chapter Gamma Sigma Epsilon, Senior.
Omicron Delta Kappa	Mr. Richard B. Emerson, Secretary, Alabama Chapter, Senior, Law
Pi Mu Epsilon	Miss Mary Lee Patton, President, Alabama Chapter Pi Mu Epsilon, Senior
Tau Beta Pi	Mr. Patrick N. Morgan, President, Alabama Chapter, Senior.

The formal installation was carried out at 2:30 p.m. according to the following program:

FORMAL INSTALLATION
OF THE
ALABAMA CHAPTER
OF THE
SOCIETY OF THE SIGMA XI
PROGRAM

Meeting called to order	Dr. Walter B. Jones, President, University of Alabama Sigma Xi Club
Presentation of Installing Officers	Dr. Walter B. Jones
Reading of the petition for the establishment of a chapter of Sigma Xi	Dr. William P. Ott. (Sigma Xi, Chicago, 1916) Chairman Invitations Committee. Head of Department of Mathematics
Announcement of the action of the Executive Committee and National Convention on the petition	Dr. Edward Ellery, National Secretary of the Society of the Sigma Xi

Adoption of the Chapter Constitution
and By-Laws

Constitution and By-Laws presented by

Dr. James L. Kassner, (Sigma Xi, Michigan, 1925) Chairman Committee on Constitution and By-Laws

Report of Committee on Nominations
and election of Chapter Officers

Dr. Stewart J. Lloyd, (Sigma Xi, Chicago, 1937) Chairman Committee on Nominations

Installation of Chapter Officers

Dr. Edward Ellery, National Secretary, Installing Officer

Newly elected President takes chair

Dr. Emmett B. Carmichael

Presentation of the Charter for the
Chapter

Dr. George A. Baitzell, Nat. President, the Society of the Sigma Xi

Acceptance of the Charter

Dr. William P. Ott

Charge to the Chapter

Dr. George A. Baitzell, National President of the Society of the Sigma Xi

Following the installation a reception and tea in honor of distinguished guests and visitors was given by the women members of Sigma Xi and the wives of members in the Lounge and Auditorium of the Alabama Union Building at 4:00 p.m. Mrs. Neva Drummond Foley (Sigma Xi, Wisconsin, 1925) was chairman of the reception committee. Dr. Richard C. Foster, President of the University; Dr. George A. Baitzell, National President of Sigma Xi; Dr. Edward Ellery, National Secretary of Sigma Xi; Dr. N. F. Greenhill, President of Livingston State Normal; Dr. J. A. Keller, President of Florence State Teachers College; Dr. Walter B. Jones, Past President of Sigma Xi and Mrs. Jones; Dr. E. F. Richards, Past Vice-President of Sigma Xi and Mrs. Richards; Dr. Emmett B. Carmichael, President, Alabama Chapter of Sigma Xi, and Mrs. Carmichael; Dr. J. D. Mancill, Past Treasurer of Sigma Xi, and Mrs. Mancill, and Dr. and Mrs. James O. Foley, were in the receiving line.

Mrs. George J. Davis, Jr. and Mrs. Emma Scarborough were at the tea table.

The installation program was concluded with a formal banquet held in the Tutwiler Dining Hall of the University with Dean S. J. Lloyd as toastmaster. Dr. Richard C. Foster, President of the University, extended a hearty welcome to the chapter of the Sigma Xi and expressed his personal satisfaction and that of the University administration at the establishment of a chapter at the University of Alabama. The toastmaster introduced the chapter and club delegates and read a list of the chapters and clubs that sent congratulatory messages. The installation address, "*Uniformity in Nature*" was delivered by Dr. George A. Baitzell.

SIGMA XI CHAPTERS REPRESENTED BY DELEGATES

Cornell	Dean Jacob Davis, Jr.
Yale	Dr. Charles M. Goss
Minnesota	Professor Thomas G. Andrews
Philadelphia	Dr. J. Gordon Carlson
California	Dr. Russell W. Cowan
Columbia	Dr. Benjamin A. Wooten
Chicago	Dr. Thomas E. Hunt
Michigan	Dr. George T. Fane
Case	Professor Arthur R. Bauder
Colorado	Dr. Emmett B. Carmichael
Missouri	Mr. Philip H. Delano
Northwestern	Mr. William H. Coghill
Syracuse	Dr. Stuart Graves
Texas	Dr. Elsie Bodemann
North Carolina	Dr. Alfred Ridner Macormac
Virginia	Dr. James S. McLester
California Institute of Technology	Dr. Clyde B. Crawley
Duke	Dr. A. L. Joyner
Wesleyan	Dr. John Gray

SIGMA XI CLUBS REPRESENTED BY DELEGATES

University of Mississippi	Dr. Frank M. Hull
Utah State Agricultural College	Dr. Allen D. Keller
Alabama Polytechnic Institute	Dr. W. D. Salmon

CONGRATULATORY MESSAGES FROM SIGMA XI CHAPTERS
AND CLUBS

CHAPTERS

Union	McGill	California at Los Ang
Rensselaer	Kentucky	Mass. Inst. of Tech
Kansas	Johns Hopkins	Tulane
Nebraska	Cincinnati	Smith
Brown	Michigan State	Carleton
Stanford	Maryland	Buffalo
Illinois	Oklahoma	George Washington
Wisconsin	State Col. of Wash.	Utah
Univ. of Washington	Wyoming	Oregon State
Purdue	Rochester	Rice
Mayo Foundation	Pittsburgh	Florida
N. Carolina	Western Reserve	West Virginia
Iowa State	Princeton	

CLUBS

Southern California	University of Arkansas	University of Georgia
University of Denver	Univ. of Cal. at Davis	Bucknell University
Colorado State College	St. Louis University	University of Montana
Louisiana State Univ.	Connecticut State College	Virginia Polytechnic Inst.

Congratulatory messages were received from the following individuals:

- Mr. Harold F. Norton, former member Executive Committee Sigma Xi.
- Dr. T. V. Neal, President Howard College.
- Dr. Raymond R. Paty, President Birmingham Southern College.
- Dr. T. M. Simpson, acting Dean, Graduate School, University of Florida.
- Dr. R. V. Allison, Head Department of Soils, University of Florida.
- Dr. C. F. Korstian, Dean School of Forestry, Duke University.
- Dr. John Xan, Professor of Chemistry, Howard College.

EMMETT B. CARMICHAEL, *President.*

Newfoundland: Geology and Peoples

(Concluded from page 112)

day in the year. A visit to Newfoundland will be well repaid with lasting memories.

SELECTED REFERENCES

- Daly, R. K., Post-glacial warping of Newfoundland. *Am. J. Sci.*, I (1921), 381-391.
- Schuchert, C., and Dunbar, C. O., Stratigraphy of Western Newfoundland, *Geol. Soc. Am., Mem.* 1 (1934).
- Snelgrove, A. K., Mines and mineral resources of Newfoundland, Information circular No. 4 (1934).
- Twenhofel, W. H., Physiography of Newfoundland, *Am. J. Sci.*, 33 (1912), 1-24.

The West Virginia Installation

(Concluded from page 115)

The address of the evening, "The Urge to Know, and Academic Freedom" was given by Dean Edward Ellery of Union College.

The program was closed with a rising vote of thanks to the two National officers of the Society of the Sigma Xi.

C. L. LAZZELL, *Secretary.*

MINUTES OF THE MEETING OF THE EXECUTIVE COMMITTEE OF SIGMA XI

April 26, 1938, Washington, D. C.

A stated meeting of the Executive Committee was held in the Cosmos Club, Washington, D. C., April 26, 1939. The meeting was called to order by President Baitzell at 2.00 P.M. Present were: President Baitzell, Secretary Eller, Treasurer Pegram, Professors Miller, Gortner, Lund, Shapley, Durand, Anderson, Mr. Davies; and, by invitation, F. R. Moulton, F. K. Richtmyer, G. H. Parker, past presidents; L. J. Stadler, past member of the Executive Committee; Watson Davis and Robert Potter of Science Service. Business was transacted as follows:

1. INTRODUCTIONS AND ANNOUNCEMENTS:

President Baitzell introduced Dr. Carl D. Anderson, elected as a member of the Executive Committee at the 39th annual convention.

President Baitzell announced the installation of two new chapters—the West Virginia Chapter March 30, and the Alabama Chapter April 4, with the President and the Secretary serving as installing officers.

The President reported a visit to the Cincinnati Chapter, and to the clubs at Louisiana State University and at Emory University.

He also reported attending a meeting on College Honor Societies under the auspices of the Bureau of Education of the United States Department of the Interior.

2. PRELIMINARY INFORMATION ABOUT INSTITUTIONS:

a. Southern California.

b. Virginia Polytechnic Institute.

Reports of surveys of these institutions made by official visitors were received and considered at the December meeting of the committee. It was

Voted—That each of the institutions prepare a formal printed petition for consideration of the committee at the December, 1939, meeting.

c. Oberlin College.

Detailed information about equipment and resources of Oberlin College had been in the hands of the Executive Committee since the first week in April. The conditions which obtain at the institution were fully discussed at the meeting. It was

Voted—That the president be authorized to appoint an official visitor.

d. Bryn Mawr College.

Detailed information about resources and equipment and work in science at this institution had been distributed to the committee the first week in April. After full discussion of this information, it was

Voted—That the president be empowered to appoint official visitors.

2. MEMBERSHIP STRUCTURE:

At the December meeting of the Executive Committee, and also at the 39th annual convention, both held in Richmond, a question was raised about the advisability of continuing the present distinction between associates and members. The president was authorized to appoint a committee to consider the whole matter of the membership structure of the society for report at some future meeting of the Executive Committee. At the suggestion of the president, prior to the appointment of the committee, chapters had been asked to express their opinion about the present membership structure of the society. A result of that circularization showed distinct differences of opinion. Some of the chapters prefer the present arrangement, by which distinction is made between undergraduates who have shown marked excellence in science courses but had not done any research work, and undergraduates or post-graduates who had actually carried out a piece of research. The opinion prevails at other chapters that only graduate students and faculty members should be elected into the society, but that the differentiation between associates and members should be continued. Other chapters prefer not only *not* to elect undergraduates, but to elect graduate students to membership only.

The secretary reported that some of the chapters had asked about the possibility of electing so-called "life members," or "honorary members," or "patrons" of Sigma Xi. The secretary reported that a suggestion had been received that the society use the designation "fellow" in its classification of constituents.

In view of this report and the discussion, the president announced that he would appoint a committee on membership structure to consider the present policy of the society, all these suggestions regarding it and others that may be received, and to make report to some future meeting of the committee, and possibly through the committee to the annual convention.

3. "SCIENCE IN PROGRESS":

The president presented to the committee advance copies of a volume entitled "Science in Progress," which contains the national Sigma Xi lectures delivered in 1937 and 1938. The editor of the work is the president of the society, and the book contains a foreword by Professor Harlow Shapley. The book is published by the Yale University Press without financial obligation on the part of the society. It retails for \$4.00 per volume.

The committee expressed to President Baitzell its sincere and profound appreciation of the splendid work he has done as editor, and its definite opinion that the publication is an important scientific publication and constitutes a valuable contribution to the literature of science of today. It was

Voted—That the secretary be authorized to distribute among the 40,000 members and associates of Sigma Xi a descriptive folder announcing its publication and sale; that the cost of printing the folder should be charged against the profits accruing from the sale of the book by the society; that the remainder of the profits should be credited to the fund for grants-in-aid of research.

4. GRANTS-IN-AID OF RESEARCH:

It was

- Voted*—1. That the policy of awarding grants-in-aid be continued during the academic year 1939-40;
2. That the secretary be authorized to circularize Sigma Xi alumni members and associates, soliciting contributions to the research fund;
3. That the society appropriate for grants-in-aid the sum of \$600 from the interest on the Semi-Centennial fund, and that it underwrite to the extent of \$1,550 the returns from the circularization of the alumni;
4. That the sum of \$250, being the unexpended returns from previous circularizations, be used in the academic year 1939-40;
5. That the total amount to be used for grants-in-aid be not more than \$2,400 plus any amount by which new contributions to the fund shall exceed the underwriting of \$1,550;
6. That the total to be expended in the academic year 1939-40 shall not, in any case, be more than \$3,000.

The list of awards for 1938-39 appears in the Report of the President in the March QUARTERLY.

5. REPORT OF THE COMMITTEE ON PUBLICITY:

Following the vote taken at the December, 1938, meeting of the Executive Committee, President Baitzell appointed Messrs. Davies, Ellery and Watson Davis (Science Service) a committee to consider worthwhile publicity in the interest of research in science and of the society itself. A meeting of the committee was held in New York on January 31, and it was agreed that Mr. Davis would take the responsibility of finding a proper individual to handle the actual work of preparing releases and supervising their dissemination. The members of the committee were agreed that such person should be paid for his time, and that the expenses of mailing the releases should be borne by the society itself.

(Following the meeting of the sub-committee on publicity, the members of the Executive Committee authorized by a mail vote the expenditure of \$200 to cover these expense items.)

The Committee on Publicity noted several items of the society's activities which lend themselves to publicity, together with the suggestions about handling them:

1. *General.* The secretary should supply Mr. Davis with background material such as Sigma Xi History, constitution, current list of chapters and clubs, list of officers and committee personnel, etc.
2. *Lectures.* The secretary to supply Mr. Davis with statement of purpose of lectures, advance copy of each lecture, biographical material about lecturers and itineraries. After material is sent in, the secretary should wire any changes in plans.

This item will lend itself to national releases and local releases.

3. *Grants-in-Aid.* Mr. Davis should have personnel of committees on grants, with biographical sketches, names and addresses of recipients, basis for grants and amounts of grants, brief statement of education and research experience of each recipient.

National and local releases.

4. *Issues of the QUARTERLY.* The secretary should send page proof or corrected galleys at least ten days before date of issue of QUARTERLY. Also biographical data on all authors.

National and local releases.

5. *Spring Meeting of Executive Committee.* Mr. Davis should have copy of the agenda three days before the meeting. He will suggest items that may be of publicity interest, and arrange for coverage.

National release.

6. *Sigma Xi Lecture at Columbus A. A. A. S. Meeting.* Arrangements made by A. A. A. S. to handle publicity should be checked by Sigma Xi man.

Note on Biographical Material: Where any individual to be dealt with is included in Who's Who, American Men of Science, or similar reference work, it will be ample to note that fact instead of preparing additional information.

Mr. Davis and his associate, Mr. Potter, reported that to date their organization had issued releases as follows:

1. The 1939 Sigma Xi lecture series:

(Names and topics appear in the Report of the President, March QUARTERLY.)

2. Chapter installations at West Virginia and Alabama.

It was

Noted—That the Executive Committee express its profound gratitude to Mr. Davis and Mr. Potter and the organization of Science Service for the wide publicity they had already brought about to these activities of Sigma Xi.

6. REPORT OF THE COMMITTEE ON QUARTERLY.

Acting upon the authority of the Executive Committee, President Baitzell appointed Dean Richtmyer chairman of a committee to study the improvement and expansion of the QUARTERLY, and asked Dean Richtmyer to name other members of the committee. The full committee, consisting of Professor Harold C. Urey of Columbia, Mr. Watson Davis of Science Service, President Baitzell and Secretary Ellery, met January 31 in New York City. The entire subject was fully discussed in a session which occupied most of the day. A complete report was sent to the members of the Executive Committee April 1. Included in the report were the following recommendations:

1. That the SIGMA XI QUARTERLY be enlarged to contain some 500 to 600 pages per year; that the present name "Sigma Xi Quarterly" be retained for the present; and that it continue to be issued as a quarterly.

2. That the added space be used to report for the benefit of the general membership of Sigma Xi recent advances in the various fields of science encompassed by the society. Presumably the QUARTERLY should continue to report the deliberations of annual meetings, the Executive Committee and the activities of officers; and also the more important and appropriate scientific addresses and symposia delivered before chapters.

3. That there be an editorial board, appointed by the Executive Committee, consisting of an editor-in-chief and, say, twelve associate editors, each representing a major branch of science. The editor-in-chief might be appointed without term, or for a rather long term. The associate editors should be appointed on a rotation basis. If there are twelve, they might serve for four years, three being appointed each year. The duties of the editorial board would be those usually pertaining to such a board.

4. That the editor-in-chief should receive an honorarium for his services—say, \$500 to \$1,000 per year, to be fixed by the Executive Committee—and that the editorial board be authorized to pay honoraria to authors who may be invited to prepare the special summaries of research in the several fields. It was suggested that \$50 per author would be adequate for this purpose.

5. That the subscription price be increased to something like \$2 per year for non-members, with one dollar per year allocated to the QUARTERLY from dues paid by active members, through their respective chapters, to the national treasury. These suggested rates are solely for illustrative purposes. The whole question of cost of publication and potential revenues would be studied in detail by the special committee suggested below. We understand from Secretary Ellery that the present QUARTERLY, with a circularization of 17,000, costs for manufacture and distribution something over \$500 per issue. This does *not* include editorial costs or costs of handling subscription lists, all of which costs are now absorbed in the Secretary's office.

6. That if the Executive Committee approves the general recommendations herein presented, there be assigned either to another special committee or to the present committee enlarged by the addition of two specialists, one on cost of periodicals and the other on format, the question of working out detailed plans for editing and publishing the enlarged journal, such plans to be reported to the Executive Committee at its December, 1939, meeting. Since presumably any such plan will involve making the annual assessment on active members not less than one dollar, these plans, after consideration by the Executive Committee, should be reported to the annual Convention for approval.

7. That pending the detailed study by the committee recommended in paragraph 6, the secretary be authorized to circularize the alumni membership to ascertain how many alumni members might be willing to subscribe to such an enlarged journal. This information should be in the hands of the Executive Committee for its December meeting.

It was

- Voted*—1. To adopt recommendation No. 3, and to ask the committee on QUARTERLY to recommend to the Executive Committee a detailed plan to cover the editorial conduct of the QUARTERLY, and to present nominations of editor and editorial board.
2. To continue the Committee on QUARTERLY with such additional members as they may consider advisable.
3. To ask the committee to consider further the other recommendations in its report, and to submit a supplementary report at the December meeting of the Executive Committee.

7. REPORT OF COMMITTEE ON SIGMA XI LECTURES.

The secretary reported that in the vote taken by mail on the question of whether the society should continue the Sigma Xi lecture series for 1940, the vote was unanimous in favor of such continuance.

President Baitsell appointed as the committee on lectures for 1940 Professor H. Jermain Creighton, Swarthmore, chairman; Professor Harlow Shapley, Harvard, and Dean DuBridge, Rochester. A meeting of the committee was held April 20 in New York City, with President Baitsell, Mr. Davies, and Secretary Ellery present by invitation.

The committee was unanimously of the opinion that:

1. The 1940 lectures should be distributed among several fields of science;
2. The invitations should be sent to Messrs. Cushing, Parker, Fletcher, Langmuir, and Bush; and that the following alternates be chosen: for Dr. Cushing, E. A. Hooton and J. F. Fulton; for Dr. Parker, F. S. Went and J. F. Fulton; for Dr. Fletcher, J. W. Beams and Brian O'Brien; for Dr. Langmuir, D. A. MacInnes and Linus C. Pauling; for Dr. Bush, Dr. Davis and President Bowman. It was decided to select Dr. J. F. Fulton as alternate for Dr. Cushing, only in case Dr. G. H. Parker refused the committee's invitation.

Promises were obtained from Professors Baitsell and Shapley to participate in the 1941 program.

It was

Voted—To accept and approve the report of the Committee on Lectures.

8. SIGMA XI IN INDUSTRIAL RESEARCH LABORATORIES.

The secretary presented letters from Dr. C. C. Brown, second president of the national organization, now connected with the University of Florida, in which the suggestion was made that the Executive Committee consider whether the time had arrived for the society to establish chapters in industrial research laboratories. After some discussion, it was

Voted—To refer the subject to the committee on membership structure.

9. CERTIFICATES IN COMMENDATION OF RESEARCH.

These awards were discontinued in 1938. Professor Stewart, with whom this activity of Sigma Xi originated, submitted a letter expressing his regret at the action of the committee, and asked the following questions:

- a. Is there any evidence that research has been, or has not been, noticeably promoted by the granting of these certificates in institutions in which there are no chapters of Sigma Xi?
- b. Is there any evidence that the students participating have been benefited? Is anything known of their subsequent careers?
- c. In view of the discouraging effect of the depression on research activities of less privileged institutions, is it advisable for Sigma Xi to devise some form of activity looking to the encouragement of the research workers in institutions where the society does not have chapters?

It was

Voted—1. To assure Professor Stewart of the continued interest of the Executive Committee in the project, and to express the regret of the committee that the work connected with the movement made it necessary to discontinue it.

2. That the secretary inform Professor Stewart that:

- a. Evidence of noticeable expansion of research in institutions, to students of which certificates have been granted, is lacking;
- b. That there is every evidence that individual students to whom certificates have been granted were encouraged by the award;
- c. That no information about subsequent careers of those to whom certificates have been granted has been sent to the secretary's office;
- d. That the amount of time of research men needed to judge carefully the theses submitted seems too large in comparison with the probable good results.
- e. That since the society is continually expanding in the organization of chapters at institutions (the total number to date being seventy-eight, with ten more in prospect), it is the opinion of the committee that the society is doing all it should undertake at present in attempting to exert its influence over a wider range of institutions.

10. CHAPTER PRIVILEGES AND DUTIES AS DEFINED IN THE CONSTITUTION.

The secretary called the attention of the committee to an apparent discrepancy in the definition of duties and privileges of chapter associates as given in Sections 1, 4 and 5 of Article III of the national constitution. Section 2 of Article III declares that the membership of an institutional chapter is composed of members or associates of the society who are actively connected with the staff or student body of the institution; also of alumni members and associates who may become affiliated with the chapter. The section further declares that alumni members and associates have all the privileges and duties of chapter members and associates except voting. The duties and privileges of chapter members and associates are not defined, but the privilege of voting is definitely prohibited to affiliated members and associates.

Section 4 of Article III makes voluntary with the chapter the election of associates, and Section 5 definitely limits the privileges and duties of associates by withholding the right to vote. The secretary emphasized the necessity of a clearer definition of voting and non-voting chapter members.

Since this whole matter is connected with the question of membership structure, it was

Voted—To request the committee on membership structure to consider constitutional definition of duties and privileges of chapter membership.

11. THE BUDGET FOR 1939.

Treasurer Pegram presented the following proposal for the 1939 budget, with comparison figures of the 1938 budget and 1938 expenditures.

	1939 Proposed Budget	1938 Budget	1938 Expendi- tures
1. Secretary's office			
(a) salaries, clerical assistance	\$ 4,400	\$ 4,400	\$ 3,432.00
(b) postage, express, telegrams, stationery, sup- plies	700	1,000	388.25
(c) circularization of alumni for research contribu- tions	600	.....	579.63
2. Treasurer's office	200	200	200.25
3. Officers' travel expenses	1,400	1,400	1,119.27
4. QUARTERLY (4 issues)	3,000	3,000	2,735.10
5. Engrossing charters	200	200	159.70
6. Travel expenses of Sigma Xi lecturers	1,500	1,500	1,386.62
	\$12,000	\$11,700	\$11,000.82

It was

Voted—To adopt the budget for 1939 as proposed.

The treasurer reported special gifts as follows:

From Dr. Durand, \$100.

From the Virginia Chapter, \$50.

From the Swarthmore Chapter, \$50.

From the Ohio State Chapter, \$15.

It was

Voted—1. To express to the contributors of these gifts, on behalf of the national society, grateful appreciation for these gifts;

2. That the gift from Dr. Durand be added to the surplus account of the treasurer;

3. That the gifts from Virginia and Ohio State be added toward the support of the Sigma Xi lecture series;

4. That the gift from the Swarthmore Chapter be added to the Semi-Centennial Fund.

Upon the recommendation of the treasurer, it was

Voted—That the Executive Committee authorizes the treasurer to assent for the Sigma Xi Society to the Plan of the Baltimore and Ohio Railroad Company for Modification of Interest Charges and Maturities, dated August 15, 1938, and to deposit in accordance with this plan the Baltimore and Ohio Railroad Company \$1,000 5% (2,000) Refunding and General Mortgage bond owned by the Society.

12. QUESTIONS OF ELIGIBILITY.

a. One chapter presented a list of publications of a possible candidate for membership which dealt exclusively with questions of farm management

and agricultural economics, and asked whether in the opinion of the Executive Committee the author of the articles was eligible on the basis of that sort of work and publication. It was

Voted—That the research work of the individual did not come within the field of research covered by the Society of the Sigma Xi.

b. A chapter presented the question of eligibility of a candidate on the basis of work done by an individual who had been trained as an engineer, but whose career had been in the field of patent law practice. It was

Voted—That the achievements of this individual in his chosen field did not come within the scope of the research work recognized by Sigma Xi.

13. THE TIME OF THE ANNUAL CONVENTION; THE SIGMA XI EVENING AT THE DECEMBER MEETINGS.

Several members of the committee called attention to the lack of time allotted to the annual convention for the complete and adequate transaction of the increasingly expanding business of the society. Attention was also called to the fact that for sixteen years the second general evening of the December meetings of the A. A. A. S. had been definitely filled by a Sigma Xi lecturer, and that at the Richmond gathering the Executive Committee of the A. A. A. S. had been compelled to introduce an additional lecture at the Sigma Xi evening. During the discussion on these two important topics it became clearly apparent that the consensus of opinion of the committee was that the Sigma Xi evening at the December meetings should be reserved exclusively for Sigma Xi; and further, that at some time in the near future it might be wise to institute the policy of an occasional convention independent of the Association meetings or the meetings of any other organization. It was

Voted—To keep these topics on the agenda of future meetings of the committee.

14. PARTICIPATION OF CLUBS IN THE AFFAIRS OF THE NATIONAL SOCIETY.

In the last ten years the relations of Sigma Xi clubs to the national organization have been growing in intimacy. At the 39th convention an amendment to the constitution was definitely adopted which recognized and authorized the organization of Sigma Xi clubs, and defined their privileges and duties in the national organization. The question was raised as to whether the privilege of making financial contribution to the national organization by meeting the annual assessment voted by the convention should be extended to the clubs. The committee felt that the time had not come to take definite action on the proposal, and it was

Voted—That the matter of club participation in the financial support of the national organization be kept on the agenda of future meetings of the committee.

EDWARD ELLERY, *Secretary*.

SIGMA XI CLUBS

CLUB	PRESIDENT	VICE-PRESIDENT	SECRETARY	TREASURER
.....	R. W. Truesdail.....	.....	J. A. Hartley.....	J. A. Hartley
.....	B. Cohn.....	.....	Margaret Boos.....	Margaret Boos
.....	E. R. Hitchner.....	W. E. Bradt.....	B. Speicher.....	B. Speicher
.....	N. A. Christenson.....	R. F. Taylor.....	Ruth Sumner.....	Ruth Sumner
.....	R. L. Menville.....	L. W. Morris.....	E. L. Miller.....	E. L. Miller
.....	W. S. Dyer.....	.....	W. R. Horsfall.....	W. R. Horsfall
.....	G. A. Richardson.....	.....	T. H. Jukes.....	T. H. Jukes
.....	W. W. Atwood.....	.....	P. M. Roope.....	P. M. Roope
.....	D. W. MacCorquodale.....	L. F. Yntema.....	A. E. Ross.....	.....
.....	G. C. White.....	R. M. DeCoursey.....	D. C. G. Mackay.....	D. C. G. Mackay
.....	W. H. Shideler.....	.....	R. V. Van Tassel.....	R. V. Van Tassel
.....	D. C. Boughton.....	.....	G. W. Crickmay.....	G. W. Crickmay
.....	W. N. Lowry.....	.....	R. L. Anthony.....	.....
.....	J. C. Ireland.....	D. I. Purdy.....	J. E. Webster.....	J. E. Webster
.....	D. B. Swingle.....	H. T. Ward.....	P. L. Copeland.....	P. L. Copeland
.....	L. M. Roderick.....	H. H. Flor.....	H. E. Wirth.....	H. E. Wirth
.....	W. M. Craig.....	E. L. Reed.....	W. W. Yocum.....	.....
.....	F. O. Smith.....	G. D. Shallenberger.....	C. W. Waters.....	.....
.....	S. A. Wingard.....	.....	W. L. Threlkeld.....	.....
.....	S. D. Wilson.....	K. P. Young.....	H. C. Chang.....	H. C. Chang
.....	W. A. Ver Wiebe.....	C. C. McDonald.....	E. A. Marten.....	E. A. Marten
.....	C. A. Frey.....	D. B. Green.....	C. Denbow.....	C. Denbow
.....	R. E. Holzer.....	G. V. Martin.....	L. S. Gill.....	L. S. Gill
.....	R. G. Stone.....	J. E. Wildish.....	L. Misbach.....	L. Misbach
.....	R. E. Kirk.....	C. C. Whipple.....	W. H. Gardner.....	W. H. Gardner
.....	H. P. Pettit.....	D. R. Swindle.....	J. F. H. Douglas.....	.....
.....	Mary Pinney.....	.....	M. J. Martin.....	.....
.....	D. P. Boder.....	.....	Helen S. Mackenzie.....	.....
.....	F. M. Hull.....	A. B. Lewis.....	G. W. Parsons.....	G. W. Parsons
.....	W. R. Adams.....	W. R. Adams.....	R. G. Daggs.....	R. G. Daggs
.....	S. Maeser.....	J. S. Williams.....	L. B. Linford.....	L. B. Linford
.....	J. K. Nicholes.....	.....	M. Marshall.....	M. Marshall
.....	C. Welty.....	.....	N. Bennington.....	N. Bennington
.....	W. D. Salmon.....	G. Volk.....	K. C. Barrons.....	.....
.....	O. R. Quayle.....	J. H. Purks.....	E. Papageorge.....	W. B. Redmond
.....	J. L. Stuckey.....	F. W. Sherwood.....	I. D. Jones.....	I. D. Jones

Secretary.

CHAPTER OFFICERS

List Furnished by the Secretaries of the Chapters

CHAPTER	PRESIDENT	VICE-PRESIDENT	SECRETARY
Cornell	J. M. Sherman	C. C. Murdock	L. Spencer
Rensselaer	H. S. Van Klooster	H. E. Stevens	D. T. Smith
Union	F. J. Studer	E. M. Ligon	A. H. Fox
Kansas	H. B. Hungerford	A. W. Davidson	W. H. Schoewe
Yale	E. J. Miles	F. T. McNamara	L. F. Nims
Minnesota	L. S. Palmer	L. I. Smith	E. A. Donelson
Nebraska	M. G. Gaba	J. E. Weaver	E. R. Washburn
Ohio State	H. C. Sampson	L. H. Snyder	P. B. Stockdale
Pennsylvania	J. R. Kline	D. H. Wenrich	E. M. Landis
Brown	R. B. Lindsay	Z. R. Bliss	P. H. Mitchell
Iowa	E. W. Chittenden	E. Bartow	D. Lewis
Stanford	E. Blackwelder	J. P. Baumberger	K. M. Cowdery
California	C. D. Shane	H. Kirby	L. E. Reukema
Columbia	H. W. Webb	A. W. Thomas	D. P. Mitchell
Chicago	C. R. Moore	A. J. Dempster	H. C. Hesselstine
Michigan	A. H. Higbie	H. H. Willard	J. S. Gault
Illinois	C. L. Metcalf	W. L. Schulz	E. G. Young
Case	F. Whitacre	R. Shankland	R. L. Burington
Indiana	G. S. Snoddy	R. J. Hartman	M. L. Lohman
Missouri	S. Brody	H. E. French	L. J. Wells
Colorado	I. C. Hall	W. Thompson	H. Hoffmeister
Northwestern	C. H. Behre, Jr.	C. A. Rymer	N. C. Jamison
Syracuse	N. F. Lindeman	C. A. Ivy	J. Russell
Wisconsin	L. E. Noland	N. E. Artz	J. G. Winans
Univ. of Wash.	M. L. Price	C. A. Richards	Rex Robinson
Worcester	M. G. Mellon	D. H. Loughridge	W. E. Lawton
Purdue	A. S. Gilson	C. J. Klemme	E. J. Kohl
Washington Univ.	V. du Vigneaud	N. H. Hicker	Florence M. Heys
Dist. of Columbia	A. Romberg	D. McConell	O. S. Adams
Texas	G. M. Higgins	J. L. Bollman	G. H. Fancher
Mayo Foundation	H. D. Crookford	J. W. Huddle	E. Allen
N. Carolina	E. O. North	C. R. Byers	J. E. Magoffin
N. Dakota	C. Y. Cannon	J. M. Aikman	A. R. Oliver
Iowa State	D. L. Cottle	Mrs. R. L. Starkey	D. L. Holl
Rutgers	B. P. Bakkin	T. H. Clark	W. R. Robins
McGill	M. M. White	O. Maass	J. B. Phillips
Kentucky	H. S. Owens	O. Koppius	L. H. Townsend
Idaho	S. C. Palmer	J. Ehrlich	G. Woodbury
Swarthmore	A. F. Moursund	P. van de Kamp	H. J. Creighton
Oregon	J. H. Yoe	W. R. Todd	C. Constance
Virginia	L. J. Reed	G. T. Whyburn	J. K. Roberts
Johns Hopkins	P. W. Merrill	J. C. Hubbard	M. W. Pullen
Calif. Inst. of Technology	H. A. Taylor	H. Bateman	F. C. Lindvall
New York	G. E. Cullen	W. F. Ehret	F. E. Myers
Cincinnati	R. Hutson	F. O'Flaherty	S. B. Aranson
Mich. State	Lila Sands	J. Hawks	P. J. Schaible
Arizona	T. E. Butterfield	D. M. Crooks	F. E. Roach
Lehigh	C. G. Eichlin	H. A. Neville	P. B. Carwile
Maryland	C. O. Swanson	C. E. White	R. Bamford
Kansas State	W. H. Welker	J. S. Hughes	H. H. Laude
Col. of Medicine	F. G. Hechler	I. Pilot	I. Schour
Univ. of Illinois	G. L. Van Lear	I. B. Hill	L. A. Doggett
Pennsylvania State	H. E. Culver	J. A. Colbert	M. Hopkins
Oklahoma	A. P. Sturtevant	C. S. Holton	J. Sotola
State Col. of Wash.	S. W. Clausen	C. S. Gilbert	W. B. Owen
Wyoming	J. S. Taylor	J. E. Hoffmeister	K. W. Smith
Rochester	P. W. Bridgman	A. G. Worthing	A. E. Staniland
Pittsburgh	T. Sollmann	S. Weiss	F. M. Carpenter
Harvard	A. M. Greene	F. Hovorka	J. C. Gray
Western Reserve	W. J. Seeley	E. G. Butler	H. N. Alyea
Princeton	A. W. Bellamy	J. J. Gergen	C. G. Bookhout
Duke	S. C. Prescott	G. R. Robertson	A. H. Warner
California	W. L. Duren, Jr.	W. C. Voss	A. A. Ashdown
At Los Angeles	H. B. Goodrich	Charlotte H. Boatner	H. Cummins
Massachusetts Inst. of Technology	Myra Sampson	F. Slocum	J. W. Peoples
Tulane	A. T. Lincoln	R. Collins	L. T. Slocum
Wesleyan	J. O. Ralls	I. M. Gould	C. A. Gingrich
Smith	F. M. Weida	R. N. Jones	H. W. Post
Carleton	W. P. Cottam	G. B. Roth	F. E. Emery
Buffalo	J. B. Rosenbach	M. Hogan	I. B. Hansen
George Washington	J. E. Simmons	C. R. Fettke	Margaret Schell
Utah	A. C. Chandler	H. A. Scullen	H. C. Howard
Carnegie Inst. of Technology	C. R. Fellers	W. S. Ritchie	W. D. Wilkinson
Oregon State	Ruth Johnston	M. J. Zigler	G. H. Roeker
Rice	C. F. Byers	R. B. Becker	H. Van Rinkel
Massachusetts State	A. M. Reese	O. Rex Ford	H. W. Dodson
Wellesley	E. B. Carmichael	J. D. Mancill	L. M. Thurston
Florida			C. L. Lazzell
West Virginia			E. B. Richards
Alabama			